NUTRITION EDUCATION AND SCRATCH COOKING CHANGES IN SCHOOLS:
A MIXED METHODS STUDY OF INTERVENTIONS
IN AURORA PUBLIC SCHOOLS

by

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A thesis submitted to the
Faculty of the Graduate School of the
University of Colorado in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
Health and Behavioral Sciences
2013

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April 17, 2013

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Nutrition Education and Scratch Cooking Changes in Schools: A Mixed Methods
Study of Interventions in Aurora Public Schools

Thesis directed by Professor Deborah S. Main.

ABSTRACT

This paper examines the impact of a nutrition education intervention on food choice and consumption in elementary cafeterias. After a school district changed 42 lunch and breakfast entrée recipes to include more whole grains, fresh produce and fresh meats, this study examined student food choice and food consumption in five schools with a nutrition education intervention and five schools without. The nutrition education intervention, focusing on a 3-level rating system to teach children about healthful food (Go, Slow, and Whoa), included an assembly, classroom instruction, point of sale cafeteria labeling, parent breakfast, and nutrition-related newsletter articles. Intervention schools were matched with comparison schools using propensity score matching. Student food choice and consumption was measured with digital plate waste methodology with a final sample size of 2223 lunch trays. Students enrolled in intervention schools showed significantly increased odds of choosing white milk (OR=2.17, p=0.05) over chocolate milk or no milk. None of the other healthy eating outcome models produced significant differences between intervention and comparison schools when controlling for gender, grade, and entrée items. Qualitative interviews with physical education teachers responsible for program implementation revealed low dose and fidelity of implementation for a variety of reasons. Additional teacher support, clarification of goals and program components, and technical assistance is advised to improve program implementation.

The form and content of this abstract are approved. I recommend its publication.

Approved: Deborah S. Main

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CHAPTER I

BACKGROUND AND SIGNIFICANCE

Background

The Health Problem

Childhood obesity is a major public health concern in the United States as rates of overweight and obese children continue to rise. Since 1970, the number of obese children ages 6-11 has quadrupled and the number of obese adolescents ages 12-19 has tripled (Hedley et al., 2004; Levi et al., 2010). This exponential increase in childhood obesity has implications for current and future health of children as they become adults. The rise in childhood obesity rates may also lead to a reduction in life expectancy (Fontaine, Redden, Wang, Westfall, & Allison, 2003). Public and private schools nationwide are targeting physical activity within school hours to increase energy expenditure among students. This research specifically targeted dietary intake as many schools are also changing the nutrition environments to target knowledge, attitudes, and dietary choices among students. Given that disability and death are linked to poor dietary habits and obesity, improving nutritional intake of children as well as adults could have a significant impact on health and mortality in the United States.

Childhood obesity has immediate effects on child health. An estimated 61 percent of overweight young people (ages 5-10) have at least one additional risk factor for heart disease (i.e. high blood pressure, high cholesterol) (Freedman, Dietz, Srinivasan, & Berenson, 1999). Over the past several decades, type II diabetes has risen significantly in children (Vivian, 2006). Obese children and adolescents are at higher risk for a plethora of health issues including bone and joint problems, sleep apnea, menstrual abnormalities, and social/psychological problems such as stigmatization and poor self-esteem (Daniels, 2006; Daniels et al., 2005; Koplan, Liverman, & Kraak, 2005). There is also evidence that poor nutrition and physical inactivity leading to increased obesity and health problems are linked to poor test scores, concentration, and academic achievement (Kristjansson, Sigfusdottir, & Allegrante, 2010; Taras & Potts-Datema, 2005).

Obese children are at increased risk of becoming obese adults (Serdula et al., 1993; A. S. Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). According to a meta-analysis conducted by Serdula and colleagues (1993), 42% to 63% of obese adults were obese as children and higher levels of obesity (BMI) in childhood were linked to greater risk of adult obesity. The risk of overweight children becoming overweight adults is at least twice as high compared with normal-weight children and the persistence of overweight is greater with increasing levels of overweight (A. S. Singh et al., 2008). Given the relationship between childhood obesity and adult obesity, targeting children's dietary behavior could lead to improved dietary habits throughout life, decreased child and adult obesity rates, and avoidance of health risk in the long run.

Body Mass Index (BMI) is a commonly used metric to classify obesity, expressed as weight in kilograms divided by height in meters squared (kg/m^2). Child obesity and overweight criteria are based on the 2000 CDC BMI-for-age-growth charts for the U.S., and classify any child with a BMI at or above the 95th percentile of the sex-specific BMI growth charts as obese, in the 85-95th percentile as overweight. This is a change from previous years, where children at the 95th percentile and above were overweight, and kids in the 85th-95th percentiles were "at risk for overweight" (Barlow & Expert, 2007; Krebs et al., 2007). In 2007-2008, 16.9% of children and adolescents in the United States were at or above the 95th percentile and 31.7% were at or above the 85th percentile of BMI for age. Narrowing the category down to 6- through 11-year olds reveals that 19.6% are above the 95th percentile of BMI for age (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Childhood overweight and obesity rates in Colorado are problematic. Colorado is the 23rd leanest state for children, but has the second-fastest rate of childhood obesity increase in the nation, according to the 2010 National Survey of Children's Health (Levi et al., 2010). In 2009, the prevalence of overweight (85th to 94th percentile for BMI) among children ages 2-14 years was 13.2 percent and obesity prevalence (95th percentile and above) was 13.3 percent (COPAN, 2009), higher than the Healthy People 2010 objective of five percent for obesity.

Well-documented research highlights significant racial/ethnic and socioeconomic disparities in childhood obesity in the United States (Ogden et al., 2010; G. K. Singh, Kogan, Van Dyck, & Siahpush, 2008; G. K. Singh, Siahpush, & Kogan, 2010; Wang & Beydoun, 2007). In 2007-2008, Hispanic boys had significantly higher odds of having high BMI at three BMI cut-points (97th percentile, 95th percentile, and 85th percentile) when compared to non-Hispanic White boys. Among girls, non-Hispanic Black girls were significantly more likely than non-Hispanic White girls to have high BMI at the three BMI cut points. Singh and colleagues (2010b) highlighted higher prevalence of obesity in 2007 for Black, Hispanic, and American Indian children (over 23%) compared to White children (12%) and higher prevalence of overweight for Hispanic and Black children (over 41%) compared to White children (27%). Similar disparities exist in the state of Colorado. The obesity prevalence among non-Hispanic White children (10.9%) was significantly lower than for Hispanic children (21.2%) and non-Hispanic Black children (23.4%) between 2006-2008 (COPAN, 2009). The racial/ethnic breakdown in the current study population reveals more non-white students than white students. Averaged across 33 elementary schools participating in this research, 58% of the students were Hispanic, 17% were Black, 17% were White, 1% were Native American, 4% were Asian, and 3% identified as two or more races/ethnicities. The nutrition intervention evaluated in this study targeted a district with high racial/ethnic diversity, and was therefore poised to make a significant contribution to the dietary habits and obesity rates of a racially diverse population at high risk for childhood obesity.

The medical costs of obesity rise dramatically each year in the United States. The estimated annual medical costs of obesity increased from $74 billion in 1998 to $147 billion in 2008 (Finkelstein, Trogdon, Cohen, & Dietz, 2009). After combining costs for increased medical care, loss of worker productivity due to death, loss of productivity due to illness and disability of active workers, and loss of productivity due to total disability, the overall annual costs associated with obesity are likely much higher than those estimated costs. According to analyses by Finkelstein et al. (2008), across all payers (normal payer, Medicare, and Medicaid), obese patients had per capita medical spending that was $1,429 (42%) greater than spending for normal weight people in 2006. Medicaid and Medicare paid an estimated 42 percent of obesity-related medical expenditures in 2006. Childhood obesity, in 1998, was related to excess medical expenditures totaling $124 million (Johnson, McInnes, & Shinogle, 2006). These estimates of childhood and adult obesity expenditures are likely underestimates of the actual economic costs if other downstream costs are considered.

Social determinants of health are important predictors of childhood obesity. The social determinants of health are the circumstances in which people are born, grow up, live, work and age. These conditions are influenced by the distribution of money, resources, and power at the global, national and local levels (World Health Organization, 2012). The inequitable distribution of resources at the local level can be further divided into opportunities and resources available within neighborhoods and schools. Social determinants affect childhood obesity risk through access to fresh fruit and vegetables, safe environments, and income levels that afford opportunities for physical activity, healthcare and education. Children participating in the National School Lunch Program (NSLP) or School Breakfast Program (SBP), children in lower SES households, and children attending public schools all have a higher risk of being overweight or obese (Li & Hooker, 2010), thus linking social determinants of health, and specifically poverty, to childhood obesity. Many of the students in our nation and in the specific population targeted in this study fit the profile for social determinants of health that make healthy eating and active living difficult rather than easy.

Physical inactivity, dietary intake, genetic predisposition, illness, social determinants, and other factors contribute to childhood obesity. Given the myriad of negative social, economic, and health outcomes associated with childhood obesity, public health officials are searching for new, innovative and effective interventions. The NSLP and SBP are two national programs aimed at providing healthy food to children from low-income families during the school day. Social determinants of health that put children at higher risk of obesity could be offset by positive environmental and nutrition interventions offered within schools. Given that children spend seven to eight hours each day in school, school-based interventions and policies could positively affect the nutrition environment for half of a child's waking hours. Even though dietary intake is determined in part by child and family factors such as food preferences, monetary resources, choices, and eating behaviors, it is also a simple function of what foods are accessible to children and what knowledge they have about those foods; therefore school-based childhood nutrition and nutrition education are two logical intervention targets for improving dietary intake and preventing obesity. This study will examine two specific childhood nutrition interventions delivered in elementary schools: School Lunches and the Go, Slow, Whoa nutrition education program.

The National School Lunch Program (NSLP)

In 1932, the federal government began providing aid for school lunch programs from agencies such as the Federal Emergency Relief Administration, the Reconstruction Finance Corporation, and the Civil Works Administration. Soon thereafter, funding increased for labor in school lunchrooms and donations of surplus farm commodities to school lunch programs. The National School Lunch Program (NSLP) became permanent with the passage of the National School Lunch Act in 1946 (Congress, 1946). The act stipulated a formula for giving cash from the federal government to the states based on per capita income and population. This cash was, and still is, doled out across the state for school lunch programs, as long as requirements for school lunch contents (fat, saturated fat, total calories, iron, calcium, etc.) were followed (Hinrichs, 2010). The NSLP, subsidized by the federal government, helps to provide healthy food and adequate calories to students during the school day. Section two of the 1946 act (Congress, 1946) reads:

> It is hereby declared to be the policy of Congress, as a measure of national security, to safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities and other food, by assisting the States, through grants-in-aid and other means; in providing an adequate supply of foods and other facilities for the establishment, maintenance, and expansion of non-profit school-lunch programs.

In the 1990s, policymakers discovered that many school lunches failed to meet nutrition requirements. In 1995, they passed the "School Meals Initiative for Healthy Children" which required school meals to meet one-third of the child recommended daily allowance (RDA) of calories, protein, calcium, iron, and vitamins A and C and limit fat and saturated fat content (to 30% and 10% respectively) of total calories in order to receive reimbursement (Schanzenbach, 2009).

According to the USDA Food and Nutrition Service (U.S. Department of Agriculture, October, 2011):

1. The NSLP is a federally assisted meal program operating in over 101,000 public and non-profit private schools and residential childcare institutions.
2. The Food and Nutrition Service administers the program at the Federal level. At the State level, the National School Lunch Program is usually administered by State education agencies.
3. School lunches must meet Federal nutrition requirements but decisions about specific ingredients/foods to serve, recipes, and food preparation methods will be made by local school food authorities.
4. As of July 1, 2011, families are eligible for reduced price school meals if their income is between 130% and 185% of the federal poverty level, for which students can be charged no more than 40 cents. Families are eligible for free meals at 130% of the federal poverty level. To put these guidelines into

perspective, a family of four in the 48 contiguous states or the District of Columbia would be eligible for reduced price school meals with an annual family income of $41,348 and free meals with an annual family income of $29,055.

5. Even full-priced meals are subsidized to some extent. Local school food authorities set prices for full-price meals, but must provide meals without profit.
6. Schools with less than 60% student eligibility for free and reduced price lunch receive cash reimbursement at the following rates: $2.77 for free lunches, $2.37 for reduced-price lunches, and $0.26 for paid lunches. Schools with more than 60% student eligibility for free and reduced price lunch receive the following reimbursements: $2.78 for free lunches, $2.39 for reduced-price lunches, and $0.28 for paid lunches.
7. By the end of the first year of the NSLP, 1946-1947, about 7.1 million children were participating in the program. By 1970, 22 million children were participating. In FY 2010, more than 31 million children participated in the NSLP. Since the program officially began in 1946, over 219 billion lunches have been served.
8. The cost of the NSLP totaled $10.8 billion in FY 2010.

Food consumed by children during the school day has a significant impact on both health and educational outcomes. Previous research shows that the NSLP improves educational attainment of students eating school lunch (Hinrichs, 2010), and increases vitamin and mineral consumption as compared to non-participants in NSLP (Gleason & Suitor, 2001; Gleason & Suitor, 2003). These positive effects of NSLP are promising given that the NSLP serves approximately 60 percent of the total U.S. student population daily (Schanzenbach, 2009). In 2010, 31.5 million kids participated in the NSLP: 17.6 million free lunches (56 percent of participants), 3.0 million reduced-price lunches (10 percent of participants), and 11.1 million full-price lunches (34 percent of participants) (U.S. Department of Agriculture, 2011).

Funds supporting the NSLP have a strong impact on what is offered in schools. Schools must follow the nutritional guidelines of the NSLP in order to receive continued funds for school lunch programs. However, decisions about the specific recipes, food items, and menu choices available in each school district are made at the local level. The appeal and likability of school lunch items are functions of ingredients and taste, not just of the nutritional breakdown. A spinach and egg quiche with low-fat cheese and whole wheat crust could have the same nutritional breakdown as a bean burrito with fresh tomatoes, brown rice, low-fat cheese, and a whole wheat tortilla. However, differences in culture, race/ethnicity, past experience with similar foods, and taste/texture might make one recipe much more acceptable by the student population. Therefore, the nutritional guidelines of the NSLP combined with the knowledge and creativity of the local nutrition services personnel will determine the taste, likability, and consumption of school lunches, and their impact on child health and obesity.

According to the School Nutrition Dietary Assessment Study (SNDA-III), over 85% of schools in the United States prepared lunches that met the standards set forth by the NSLP for protein, Vitamin A, vitamin C, calcium, and iron. However, fewer than one-third of public schools served school lunches with less than 30 percent of calories from fat or less than 10 percent of calories from saturated fat (Crepinsek, Gordon, McKinney, Condon, & Wilson, 2009). Even though schools might meet national standards for *foods served*, the actual foods and quantities children *consume* from what is served is most important. However, this is seldom documented due to required time and costs of plate waste studies to determine consumption. The amount of food consumed at lunch could be influenced by the scheduling of recess before or after lunch (Bergman, Buergel, Englund, Clem et al., 2004), the length of the lunch period, peer food consumption and role modeling, and food preferences (Bergman, Buergel, Englund, & Femrite, 2004a). The estimated amount of calories wasted from school lunches in the NSLP varies widely from 12% (Devaney, Gordon, & Burghardt, 1995) to 40% (Bergman, Buergel, Englund, & Femrite, 2004b). This study examined lunches in a local school district that meet all criteria set by the NSLP by using plate waste methods to determine foods and food quantities consumed during school lunch. By utilizing quantitative plate waste methods to identify the percentage of food thrown away from school lunches, the current study fills an important gap in understanding eating habits by using quantitative methods to uncover children's eating habits and preferences.

School Nutrition and Nutrition Education Advocacy and Intervention

In addition to the NSLP, other local and national efforts are tackling the obesity problem. The U.S. Child Nutrition and WIC Reauthorization Act of 2004 ("Child Nutrition and WIC Reauthorization Act," 2004) required that school districts in the U.S. implement a Local Wellness Policy by July 1, 2006. The goals of these wellness policies were to improve students' nutritious food consumption and physical activity expenditure in order to reduce the U.S. obesity epidemic. This reauthorization act is renewed every 5 years to reflect changing demands for all school meal programs, Child and Adult Care Food Programs, and WIC.

On December 13, 2010, President Obama signed the Healthy, Hunger-Free Kids Act reauthorizing the Child Nutrition Act governing the National School Lunch Program ("Healthy, Hunger-Free Kids Act of 2010," 2010). This bill includes health-promoting school food policies such as:

1. Increasing school meal reimbursement for schools by six cents per meal;
2. Setting improved nutrition standards for school meals;
3. Setting policies for vending machines, school stores, etc.;
4. Simplifying the process for gaining access to free meals;
5. Piloting expansion of Farm to School programs as well as organic foods.

Based on their potential to impact childhood obesity and health, nutrition and nutrition education policies and interventions are an important part of many non-profit organizations and federal programs. The American Dietetic Association, the Society for Nutrition Education, and the American School Food Service Association are heavily involved in nutrition programs and interventions in schools and recommend that "comprehensive nutrition services must be provided to all of the nation's preschool through grade twelve students. These nutrition services shall be integrated with a coordinated, comprehensive school health program and implemented through a school nutrition policy" (Briggs et al., 2003). The School Nutrition Association established the School Nutrition Specialist (SNS) Credentialing Program in 1997 to help school nutrition professionals enhance their skills and elevate professional standards. This national organization also developed a tool, *Keys to Excellence,* to help dietetics professionals use a best practices framework for continuous program review, evaluation, and improvement (School Nutrition Association, n.d.). The Centers for Disease Control and Prevention and the National Association of State Boards of Education published a document titled "The Role of Schools in Preventing Childhood Obesity" (Wechsler, McKenna, Lee, & Dietz, 2004). The Farm to School national program helps schools procure fresh produce and use farm products in school lunches (*Benefits of farm-to-school projects healthy eating and physical activity for school children: field hearing before the Committee on Agriculture, Nutrition, and Forestry, United States Senate.*, 2009). Other national organizations taking part in school nutrition and school policy interventions include: the American Association of Family Physicians (AAFP), National Alliance for Nutrition and Activity (NANA), School Nutrition Association (SNA), Michelle Obama's *Let's Move* campaign, The Food Trust, the National School Boards Association (NSBA), the American Heart Association (AHA), the Coordinated School Health Program, and the Food Research and Action Center (FRAC). Within Colorado, numerous organizations have child nutrition, nutrition education and obesity prevention as part of their policy agendas, funding priorities, and advocacy issues. These organizations include: the Colorado School Nutrition Association, Colorado Department of Education, Colorado Children's Campaign, Colorado Connections for Healthy Schools, Children's Health Foundation, Colorado Legacy Foundation, Colorado Association of School Executives, Anschutz Health and Wellness Center, CU Denver, Colorado Health Foundation, Rocky Mountain Center for Health Promotion and Education, LiveWell Colorado and more. Multiple agencies and organizations are collaborating to strengthen policy and advocacy initiatives aimed at school nutrition and nutrition education. This research evaluated two such initiatives involving scratch/healthy cooking and the Go, Slow, Whoa program.

LiveWell Colorado Origins

LiveWell Colorado, a nonprofit organization committed to reducing obesity in Colorado, was established as a grant-making collaborative in 2007 in partnership with the Colorado Department of Public Health and Environment and with initial funding from The Colorado Health Foundation, Kaiser Permanente, and the Kresge Foundation. LiveWell Colorado became a 501(c)(3) in 2009 and focuses on policy, environmental and personal lifestyle changes that remove barriers to and increase healthy behaviors.

LiveWell Colorado is implementing a five-year strategic plan that focuses on the following areas:

1. Funding community coalitions throughout the state focused on healthy eating and active living strategies.
2. Informing and advancing multi-sector policy efforts with key stakeholders at the local, state and national levels.
3. Leading social marketing initiatives that inspire a culture shift and motivate sustainable healthy behavior change.

This research focused on two specific programs of LiveWell Colorado: **Culinary Boot Camps and the Go, Slow, Whoa Nutrition Education Program**. Both programs are part of LiveWell Colorado's *LiveWell @ School* initiative. Nearly 400,000 Colorado children participate in the National School Lunch Program, with about 40 percent qualifying for free or reduced lunch. Therefore, working towards improving the healthfulness of school food and delivering nutrition education in schools will have a significant impact on a large number of Colorado children. Although the overall LiveWell Colorado program is entitled *Culinary Boot Camps*, this research examined how only one district, Aurora Public Schools, implemented scratch cooking cafeteria changes following participation in the Culinary Boot Camp program. Scratch cooking changes include cooking with more whole grains, more fresh fruits and vegetables, and less processed, frozen, and canned ingredients. Therefore, this research did not necessarily evaluate the impact of the Culinary Boot Camp program, but instead evaluated the impact of specific scratch cooking cafeteria changes inspired in this one district by the Culinary Boot Camp program. Thus, this research refers to these district-level changes as “Scratch Cooking Cafeteria Changes”. *Go, Slow, Whoa* is a nutrition education program adopted and modified from national health education curriculum for use in Aurora Public Schools.

Culinary Boot Camp Inspired Scratch Cooking Cafeteria Changes:

As of the beginning of this research (August 2011), 63 Colorado school districts and 280 school food service managers and workers had participated in 5-day culinary boot camps. In Aurora Public Schools, 53 school cafeteria managers and central office leadership staff attended the LiveWell Colorado and Colorado Health Foundation sponsored Cook for America® Culinary School Food Boot Camp, which represents 16% of the total Nutrition Services Staff (kitchen managers, kitchen staff, and central office leadership and staff). This Boot Camp is taught by experienced chefs and promotes the preparation of fresh food and scratch cooking in school cafeterias at the same or lower costs than schools currently pay for processed, ready to heat and serve foods. The goal of Scratch Cooking Cafeteria Changes in Aurora Public Schools is to increase healthful nutrients (i.e. fiber, calcium, vitamins A and C) and decrease unhealthful nutrients (i.e. total fat, saturated fat, sodium, and cholesterol) in school lunch items while maintaining or increasing attractiveness, taste, and desirability. The Scratch Cooking Cafeteria Changes reflect multiple contributing strategies: using more healthful ingredients (i.e. whole grains, fresh fruits and vegetables, non-processed ingredients), creating and using new recipes with those healthful ingredients, and utilizing new techniques and kitchen equipment to prepare the recipes.

Go, Slow, Whoa

Go, Slow, Whoa (GSW) is a nutrition education program promoted by the LiveWell Colorado *LiveWell @ School* initiative. *GSW* aims to improve student and school community awareness of healthful foods, increase student’s healthful food choices and ultimately impact childhood obesity rates. *GSW* teaches children and their families about healthful foods using a green light (Go), yellow light (Slow), red light (Whoa) visual aid to symbolize foods that should be eaten frequently, sometimes, and seldom.

LiveWell Colorado has developed a business plan to scale up this intervention and offer it to additional school districts throughout Colorado. Given the paucity of data on program implementation and effectiveness, this research will make a significant contribution to program justification and program improvement.

Why Aurora?

Data collected in this school district demonstrates the need for addressing the obesity and BMI issues of elementary students. Aurora Public Schools (APS), the target school district for this study, includes two different counties: Arapahoe and Adams. Research shows that across the two counties, an average of 13.6% of children are obese, and an additional 12.4% are overweight (COPAN, 2009). These rates are significantly higher than the Healthy People 2010 goal of five percent. In APS specifically, childhood rates are much higher than the county averages. APS contains a very ethnically diverse and socioeconomically challenged student population, increasing the risk for childhood obesity. Student data collected in APS physical education classes show increasing BMIs as students advance by grade level. This points to the critical need to prevent further weight gain at the elementary school level. Given that overweight and obesity rates in APS are generally higher than the national and Colorado rates, this school district is an excellent target for healthy eating education, promotion, and programming (C. Fenton, personal communication, February 7, 2012). Many chronic diseases are related to individual and social patterns of behavior (food consumption included), thus interventions, policies, and programming targeting individual and community behavior could result in risk reduction for obesity and related diseases. This district could benefit from successful interventions to change the nutrition environment and improve student nutrition knowledge.

Significance

Scratch Cooking Cafeteria Changes and the Go, Slow, Whoa Program have potential to improve the nutritional intake of children in Aurora Public Schools. Changing children’s food options to make them more healthful and improving children’s knowledge and attitudes regarding healthy food, together, may impact nutrient consumption. Determining whether the joint effects of changing the food environment and providing nutrition education are greater than changing the food environment alone is an important question. Answering this question is key for educators and policy makers alike to implement the most effective and efficient interventions.

Objective, Rationale, and Purpose

This research, *Scratch Cooking Initiatives and Nutrition Education in Public Elementary Schools,* evaluated Scratch Cooking Cafeteria Changes and nutrition education implementation in Aurora Public Schools to determine their effect on cafeteria consumption of healthy foods. Students participating in the GSW program have opportunities to gain knowledge and skills to improve their choices and consumption of healthy cafeteria food. Aurora Public Schools implemented many scratch cooking changes beginning in August 2011, and this research assessed the consumption of menu items and ascertained differences between students in schools with GSW and schools without GSW.   Results of this research inform program justification and program improvement for both the GSW program and Scratch Cooking Cafeteria Changes.

Overview of Theoretical and Conceptual Framework

The rationale for and potential impact of school interventions addressed in this research are informed by Social Cognitive Theory (SCT) and Social Ecological Models (SEM) (Bandura, 1986; McLeroy, Bibeau, Steckler, & Glanz, 1988). Historically, many nutrition education interventions have utilized Social Cognitive Theories to guide programming targeting individual, behavioral, and environmental factors (Bandura, 2004). Although changing knowledge is an important part of nutrition education, SCT further utilizes skill building, role modeling, self-efficacy, and environmental change to reach behavior change goals. The Go, Slow, Whoa program utilizes these SCT constructs to impact student nutrition knowledge and behavior.

Social Ecological Models offer an important theoretical framework for this research by acknowledging factors outside an individual that may influence behavior.

Ecological models recognize that behavior and health outcomes are the result of more than just individual motives, and explore the interaction between an individual and the environment (Contento, 2011). The Scratch Cooking Cafeteria Changes seek to improve the food environment that students encounter on a daily basis. The Go, Slow, Whoa program works within the school nutrition environment to discuss, promote, and reinforce healthy selections from the cafeteria menu choices.

Gaps Filled

This research addressed several gaps in the current academic literature related to scratch cooking initiatives and nutrition education evaluation. Scratch Cooking school food initiatives have not been systematically evaluated in a K-12 public school context, although there is a related body of literature that examines taste preferences and consumption of fruits, vegetables, and whole grains. This research examined student responses to large-scale menu changes offering more fresh, whole grain, unrefined menu items to students in the NSLP. Plate waste studies following healthful food additions and changes are very uncommon due to the expense and time required for plate waste studies.

Nutrition education programs are oftentimes evaluated with pre-post knowledge questionnaires, 24-hour recall surveys, food journals, or food preference surveys. This research used a robust and reliable method of determining what kids actually eat by collecting data on their food consumption in the cafeteria. Digital photography plate waste protocols are in their infancy, yet show promise in collecting important and valid data about food consumption. This research further examined this method as a tool for effectively measuring school food consumption.

Lastly, unlike many studies of food consumption using quantitative data, this research also included a qualitative component to explore teacher perceptions of the intervention and program implementation and fidelity issues. This study utilized qualitative methods to understand the impact and significance of various components of the Go, Slow, Whoa program and to help explain the quantitative plate waste findings.

Research Question

How influential is the Go, Slow, Whoa nutrition education program combined with Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on elementary students' choices and dietary intake related to healthy foods?

Specific Aims and Hypotheses

Aim 1.

Determine the relative impact of GSW and Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on students' choices and consumption of school lunch.

Hypothesis 1a.

Students receiving the GSW program will *choose* more healthy foods at school than non-GSW students.

Hypothesis 1b.

Students receiving the GSW program will *consume* more of the healthy foods on their school lunch tray than non-GSW students.

Hypothesis 1c.

Students receiving the GSW program will choose and consume more overall fruits and vegetables, white milk, and fiber, and less fat and saturated fat than non-GSW students.

Aim 2.

Determine the relative dose, quality and adherence/fidelity of GSW implementation in each GSW school and relate implementation to observed outcomes.

Hypothesis 2a.

Students in schools with higher dose and better quality and adherence/fidelity of GSW programming will show more positive results of GSW programming (Hypotheses 1a, 1b, 1c).

In order to address these *Aims and Hypothese*s, quantitative digital plate waste photography and qualitative teacher interviews were conducted in 10 Aurora public elementary schools. Five schools were the GSW schools for the 2011-2012 school year, and five schools without the GSW program were matched as control schools.

To address Aim 1. Quantitative data were collected from 1st, 3rd, and 5th grade students in each school. Plate waste data were collected on the same three consecutive days in each school, therefore allowing comparison of plate waste for the same menu in each school on each day.

To address Aim 2. Qualitative physical education teacher interviews were conducted in 7 schools (three schools with GSW implementation in 2010-2011, 1 school with implementation in 2011-2012, and three schools with implementation in 2012-2013).

Informal observations and conversations within schools also contributed important qualitative data to this study aim.

CHAPTER II

REVIEW OF THE LITERATURE

Children in the United States are eating excess calories from unhealthy food. The predisposition for children to like high-fat and high-sugar foods, wide availability of unhealthy food, media persuasion, and social environments all encourage poor dietary intake (Birch, 1999; Roblin, 2007). Nutrition education in schools is one way to influence a large percentage of children in the United States. Nutrition education, as discussed in this research and in most academic literature, encompasses much more than simply lecturing about nutrients in foods and their relation to health. According to Contento (2008) "nutrition education needs to be a much more comprehensive enterprise than information dissemination in order to be effective. Nutrition education needs to address food preferences and sensory-affective factors; person-related factors such as perceptions, beliefs, attitudes, meanings, and social norms; and environmental factors" (p. 176). This chapter addresses research and theory related to different nutrition education interventions targeting food preferences and food habits, knowledge and attitudes, social norms, parental involvement, classroom instruction, and school-level environmental changes.

Theoretical Basis for Nutrition Education

Social Cognitive Theory

Social Cognitive Theory (SCT) is the most widely used theory for designing nutrition education and health promotion programming (Contento, 2011; Reynolds & Spruijt-Metz, 2006). SCT describes the interaction of dynamic and reciprocal factors (personal, behavioral, and environmental) that influence health behavior (Bandura, 1986).

Personal factors involve feelings and thoughts (outcome expectations). Behavioral factors include food-, nutrition-, and health-related knowledge and skills (behavioral capability) and skills in handling personal behaviors (self-regulation skills and self-efficacy). Environmental factors include those external to individuals, including physical and social environments (Contento, 2011). The interaction of outcome expectations, individual agency (including the skills to complete behaviors and the self-efficacy to initiate behaviors), and environmental support for behavior change are key factors of SCT that facilitate behavior change in the GSW program.

Personal factors influencing behavior include our individual thoughts and beliefs about potential actions and our personal capabilities. Human beings of all ages are self-reflective beings; self-reflection and evaluation influence personal behavior and future decisions. Among these self-reflective personal behaviors are outcome expectations. Outcome expectations can be related to physical outcomes, social outcomes, and self-evaluative outcomes (Bandura, 2000). Physical outcome expectations, in the health domain, include perceived risk of disease from not engaging in healthy behaviors or engaging in unhealthy behaviors. Positive physical outcomes related to food also include pleasant sensory experiences such as the taste or smell of something sweet (Bandura, 2000, 2004). Taste, as an outcome expectation, is a very powerful predictor of nutrition behavior in adults (Anderson, Winett, Wojcik, Winett, & Bowden, 2001), but has not been well-studied in children. Exploring and influencing the physical outcome expectations of children eating school lunch is an important aspect of nutrition education in APS.

Social outcomes include the social consequences of a behavior; for example positive peer reactions to a behavior, such as soda drinking among teenagers or consumption of Hot Cheetos by elementary school peers. The inclusion of curriculum related to positive social outcome expectations of eating healthful food will be explored with proposed qualitative methods in the current study. Self-evaluative outcomes are the beliefs one has about his or her personal actions or behaviors that result in a sense of self-worth and avoidance of behaviors that lead to dissatisfaction. Self-evaluative outcomes might include satisfaction from reducing saturated fat or soda consumption. In the EatFit program, goal setting, working towards goals, and satisfaction with achieving goals helped improve children's eating behavior (Horowitz, Shilts, & Townsend, 2004). In adults, self-satisfaction for personal accomplishments and health behaviors is one of the most powerful regulators of behavior (Bandura, 2000), however, self-satisfaction research with children and nutrition is scarce. The GSW program includes self-satisfaction learning objectives as well as learning objectives related to pleasant physical outcomes and social outcomes.

Behavioral capability, a personal factor construct in SCT, is related to health knowledge, and the cognitive, affective, and behavioral skills needed to carry out healthful behavior (Bandura, 2000, 2004). Nutrition knowledge, a target of many nutrition interventions, can pertain to facts, procedures, or behavioral skills. The GSW program specifically targets facts about nutrition to help students understand how to choose and eat more healthful food. Factual knowledge targeted in the GSW lessons includes information about food items, specific nutrients, the food guide pyramid and recommended daily allowances of nutrients. Although some research reveals that increasing knowledge about fruits and vegetables did not have a significant influence on fruit and vegetable consumption in children (Reynolds, Hinton, Shewchuk, & Hickey, 1999), other researchers show knowledge acquisition to be a precursor to behavioral capability and behavior change related to healthful eating (DeVault et al., 2009; Sauberli, Lee, Contento, Koch, & Calabrese Barton, 2008; Stevens et al., 1995; Van Horn, Obarzanek, Friedman, Gernhofer, & Barton, 2005). The GSW program is firmly rooted in knowledge acquisition, and the proposed plate waste methods will help determine whether the program (and knowledge acquisition) positively impacts dietary intake.

Observational learning and modeling, also referred to as vicarious experiences, are additional tools for increasing behavioral skills, confidence, and capabilities in children (Bandura, 1998). In elementary schools, peers, teachers, cafeteria workers, and administrators are constantly modeling behaviors related to food and nutrition. Peer, adult, and parent modeling have been strategic components of many successful school-based nutrition education interventions (Edmundson et al., 1996; Hoelscher et al., 2004; Horowitz et al., 2004; Luepker et al., 1996). The GSW program encourages school personnel to foster positive role modeling, an important component related to adoption and continuation of healthful eating and behavior. Qualitative interviews with physical education teachers explored the presence and magnitude of this modeling in selected schools.

Self-efficacy is another major motivator of action, because people must believe they can do something to actually want to initiate new behavior. Self-efficacy is crucial to overcome impediments or barriers to adopting and maintaining healthful behaviors (Bandura, 1989, 2000). The higher the level of perceived self-efficacy, the harder and longer people will be willing to persist in a new, healthy behavior or lifestyle change. Self-efficacy is especially important in beginning, modifying, and maintaining complex behaviors such as healthful eating (Contento, 2011). The GSW program and specific lessons target self-efficacy by helping students feel confident that they have the knowledge to select healthy foods, the skills to prepare healthy snacks, and the ability to convince parents to supply healthy food at home. All of these self-efficacy areas have the potential to affect student dietary intake. One nutrition education intervention for second- and third-grade students in Alabama included components to increase nutrition knowledge and student self-efficacy skills to select healthy foods both at school and at home, and reported significant knowledge gains and improved dietary behavior (Powers, Struempler, Guarino, & Parmer, 2005). The GSW program has not been evaluated for its impact on self-efficacy. However, GSW indirectly targets self-efficacy through role modeling from teachers eating school lunch in the cafeteria and healthy food messages posted throughout the school and cafeteria. Most nutrition interventions include multiple components; thus it is hard to determine the most powerful components influencing nutrition knowledge and dietary behavior. However, self-efficacy has been a component of many promising and successful nutrition education interventions with children (Edmundson et al., 1996; Gortmaker et al., 1999; Hoelscher et al., 2004; Horowitz et al., 2004; Sauberli et al., 2008). Self-efficacy is rooted in the concept of agency, or an individual's influence over his or her own behaviors and surroundings. A strong sense of personal agency is not just confidence in knowledge and skills to perform some action, but is also the ability to regulate thoughts, motivations, feelings, and behaviors or to change environmental conditions to achieve desired results (Bandura, 1989, 1998, 2000).

Qualitative interviews with physical education teachers examined their perspectives on student's personal agency and self-efficacy related to acquiring, choosing, and eating healthy foods and their inclusion of learning objectives and curriculum to target these concepts.

The final SCT construct associated with this research is environmental influence and how the environment interacts with personal and behavioral factors to impact behavior change (Bandura, 1998). The nutrition environment is the specific environment related to this research; students participating in the NSLP are surrounded by food choices and a nutrition environment chosen in part by the federal government and in part by the local school district. Scratch Cooking Cafeteria Changes to decrease fat, sugar, and sodium have altered the nutrition environment in all Aurora Public Schools, but student reactions to these changes have not been assessed. Students in GSW schools, who essentially receive two interventions (Scratch Cooking Cafeteria Changes and a nutrition education intervention), may have significantly more improved dietary intake as a result of the GSW program than students in comparison schools receiving only Scratch Cooking Cafeteria Changes. The concepts surrounding environmental changes will be discussed more fully in the next section: Social Ecological Models.

Interventions based on SCT constructs have proven effective for improving dietary behavior and reducing obesity levels in children. Successful interventions are often comprised of several components, each of which might be based on different SCT constructs and involve different levels of intervention intensity and contact hours, and thus it is difficult to outline a magic formula for necessary components. The GSW program and Scratch Cooking Cafeteria Changes utilize SCT personal and behavioral factors targeting thoughts, knowledge, behavioral capability and self-efficacy, in addition to environmental factors to influence behavior change and healthful eating. This research addresses important gaps by utilizing qualitative methods to uncover the presence of learning objectives and curriculum related to these SCT constructs. Comparing GSW school children to non-GSW school children helped uncover the impact of GSW participation.

Social Ecological Models

Altering a person's social and physical environment to improve health and health behavior fits within the framework of Social Ecological Models. Social Ecological strategies underlie the school district's Scratch Cooking Cafeteria Changes, nutrition environment modifications, and desire to strengthen the nutrition environment in schools. Factors external to an individual can have a huge impact on health and health behavior. Environmental intervention strategies target physical surroundings, social climates, information accessibility, organizational systems, and policy to provide support for improving health, and in this case, healthy eating and active living (Contento, 2011). Social ecological models of health promotion and behavior change address several "ecologies" or contexts in which people live at once. The main levels of influence are intrapersonal factors, interpersonal processes and primary groups, institutional/organizational factors, community factors, and public policy and legislation (DiClemente, Crosby, & Kegler, 2002; Green & Kreuter, 2005; McLeroy et al., 1988). In this research, children are influenced by many of these levels including their own intrapersonal factors (likes and dislikes, self-efficacy, knowledge), peer perceptions of healthy eating, and school culture and policies. Bronfenbrenner's Ecological Systems

Theory outlines the impact of environment on children and adolescents (Bronfenbrenner, 1989). Ecological Systems Theory posits that children are affected by multiple levels of influence. The microsystem includes direct influencers such as peers, family, school, and neighborhood. The mesosystem connects structures of the microsystem. The exosystem includes the larger, indirect social system and the macrosystem includes values, customs, and laws. The chronosystem incorporates the relationship between external events, the timing of those events, and the physical maturation process. The bi-directionality of each of these levels of influence is important in Ecological Systems Theory. Effective interventions are often designed for multiple levels of influence.

The following diagram outlines the use of Social Ecological Models for changing dietary behavior (McLeroy et al., 1988):

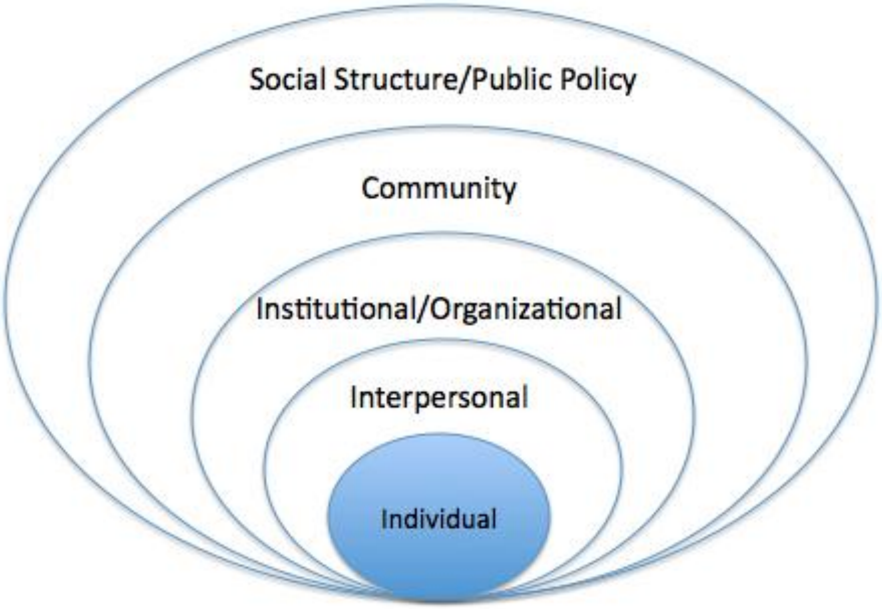


Figure 1: Theoretical Framework: Social Ecological Models

Table 1: Theoretical Framework: Social Ecological Models

Social Structure/Public Policy	Local State and Federal policies and laws that regulate or support healthy actions.
Community	Social networks, norms, or standards (e.g. public agenda, media agenda, partnerships).
Institutional/Organizational	Rules, regulations, policies and informal structures (worksites, schools, religious groups).
Interpersonal	Interpersonal processes and primary groups (family, peers, social networks, associations) that provide social identity and role definition.
Individual	Individual characteristics that influence behaviors such as knowledge, attitudes, beliefs, and personality traits.

A similar depiction of Social Ecological Models related to nutrition education, food choice and dietary practices is offered below (Contento, 2011).

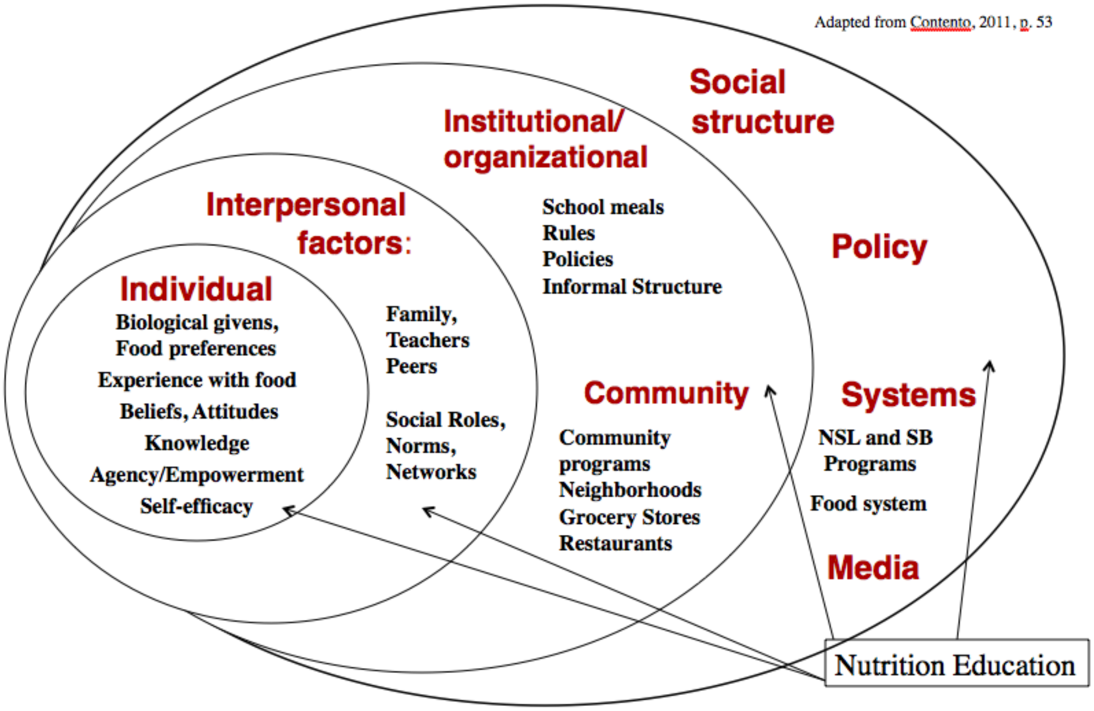


Figure 2: Social Ecological Model for Nutrition Education

At the basic level of influence, the individual level, social psychological theories of behavior change can guide interventions directed at individuals. Leading theories for nutrition education include SCT, the Health Belief Model, the Transtheoretical Model of Change, and the Theory of Planned Behavior. As already discussed, several intrapersonal constructs of SCT (beliefs, knowledge, attitudes, behavioral capability, and self-efficacy) are the basis and focus of GSW programming and were evaluated with this research. GSW programming also targets other levels of social ecological models. At the interpersonal level, peer and adult role modeling and parental involvement to influence dietary behavior are emphasized with PE teacher lessons, involvement of teachers, and parent information sessions and newsletters. Institutional, organizational, and community settings, and specifically the elementary schools in Aurora, offer opportunities to involve decision makers and policy makers in obesity prevention strategies to change relevant food and activity environments. In APS, the food service directors, cafeteria managers, administrators, and school board members are influential in improving the nutrition environment and supporting the GSW program. Developing, supporting, and introducing 41 new recipes and new scratch cooking techniques prior to the 2011-2012 school year involved collaboration from multiple organizational constituents. Beyond the local school and community level, LiveWell Colorado has offered the Culinary Boot Camp program to districts throughout the state. LiveWell Colorado also hopes to expand the GSW program to over 40 districts in Colorado and develop the program as a national model for successful nutrition education programming. These efforts will undoubtedly educate new audiences at the local, state, and national level regarding the importance of obesity prevention strategies and helpful environmental change efforts. Each of the levels of influence within social ecological models holds important promise for improving dietary habits in children (Contento, 2011), and this research was designed to evaluate two programs that address multiple levels of influence.

The school environment plays an important role in what foods kids have access to during the school day. Children could eat 35-40% of their calories at school based on the school meals program, a la carte offerings, vending machines, classroom snacks, and school stores (Briggs et al., 2003). Changing that environment to ensure the most healthful food offerings to students, and reducing availability of unhealthy food should affect the food and nutrients children consume at school. Merely increasing availability and accessibility of healthy foods in schools significantly increases consumption, as evidenced by one study targeting fruits and vegetables (Hearn et al., 1998). Simply changing what is offered shows promise in improving student dietary intake. More healthful school lunches and lunch practices are successfully reducing the consumption of energy-dense, low-nutrient foods among elementary school children. Successful strategies include offering French fries less than once a week and offering fresh vegetables and fruit daily (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009). Schools that offer French fries in school lunches more than once a week and schools that offer desserts more than once a week are more likely to have higher rates of obesity among students (Fox, Dodd, Wilson, & Gleason, 2009). Exposure to and availability of fruits and vegetables encourage increased consumption. Students with increased access to FV and more exposure to a variety of fruits and vegetables are more likely to consume larger amounts of fruits and vegetables (Briggs et al., 2003; Eriksen, HaraldsdÛttir, Pederson, & Flyger, 2003). Recognizing the benefits of access to fruits and vegetables, APS has included a salad bar at all elementary schools this year, and a goal of offering 3 fresh fruits or vegetables each day. Quantitative methods in this study assessed the amount of fruits and vegetables students are taking and the amount they are consuming each day.

The High Five project and the CATCH project changed the school environment to improve intake of fruit and vegetables with fourth- and fifth-graders, respectively (Perry, Bishop et al., 1998; Reynolds et al., 2000). Specifically, they improved variety and attractiveness of fruits and vegetables, served extra fruit choices whenever a dessert was offered, and utilized point-of-purchase signs to advocate for healthy eating. It is important to note that other nutrition education components were utilized in the High

Five project and the CATCH project, but inclusion of fruit and vegetable attractiveness, advertising, and availability components played some role in influencing fruit and vegetable intake. The High Five Project reported increases in fruit and vegetable consumption from 2.6 servings per day to 3.96 servings one year later to 3.20 servings two years later (Reynolds et al., 2000). However, the CATCH project did not report significant differences in FV intake between treatment and control groups after the nutrition intervention at the end of the school year (Perry, Bishop et al., 1998). Of particular note here is that the two programs, the High Five Project and the CATCH project, targeted similar age groups (fourth and fifth graders), utilized food environment changes and parental homework activities, included weekly lessons, and employed hands on learning, modeling, reinforcement, and skills building. Surprisingly, the successful program, the High Five Project, had far fewer contact hours with students (14, 30 minute nutrition lessons = 7 total contact hours) than the CATCH program (47, 40 minute nutrition lessons = 31 total contact hours) (Perry, Bishop et al., 1998; Reynolds et al., 2000). Another study (Cafeteria Power Plus) involving younger students (first- and third-grade students) specifically targeted environmental strategies to: (1) increase opportunities during school lunch to eat a variety of fruits and vegetables, (2) provide new healthful role models (i.e. cafeteria workers) who eat fruits and vegetables, and (3) institute social support for kids to eat fruits and vegetables at lunch (Perry et al., 2004). Students in the intervention schools (2 years of environmental cafeteria interventions) had significantly higher fruit intake (0.79 servings per lunch for intervention schools vs. 0.63 servings for control schools), but not vegetable intake (0.52 servings per lunch for intervention schools vs. 0.58 servings for control schools). These variable research outcomes highlight that it is very difficult to compare different nutrition interventions when the methods, curriculum, materials, contact hours, populations, and other strategies are quite varied. Perry et al. (2004) is one of the few research teams employing process evaluation and analysis to determine the impact of various program components. They discovered significant impact of verbal encouragement by food service staff and the number of fruits and vegetables students can choose, but non-significant effects of increasing the number of fruits and vegetables on a snack cart and increasing the appeal of fruits and vegetables. The GSW program and APS cafeteria changes employ environmental strategies to increase availability and attractiveness of fruits and vegetables, but they also use additional and varied methods, materials, contact hours and strategies. The dose and fidelity of implementation at each school is an important consideration of these environmental strategies and other GSW components and was addressed in this research.

Although some research shows that improving attractiveness and availability of healthy food increases consumption, other researchers report that if students are offered healthy and unhealthy choices side by side, they oftentimes make less healthy choices. For example, one study found that when elementary students moved from their elementary school offering only NSLP to middle school offering a la carte and snack bar meals, their intake of fruits, vegetables, and milk decreased, and consumption of sweetened beverages and high-fat, high-sugar foods increased (Cullen & Zakeri, 2004). The food environment and available foods shift as students move from elementary to middle to high schools, thus influencing their environmental supports for healthful eating. Because of the increased availability of unhealthy foods in middle school, it is important to bolster attitudes, personal motivation, and self-efficacy for choosing healthy foods in elementary school. Elementary children with greater ability to choose healthy foods should be more likely to navigate the transition to a more varied nutrition environment in middle school with more success and healthier food consumption. Although the Scratch Cooking Cafeteria Changes in Aurora elementary schools improve the nutrition environment, the GSW program aims to specifically strengthen intrapersonal factors for healthy eating in addition to other interpersonal and ecological factors related to healthy eating. These intrapersonal factors may help "protect" kids from unhealthy food choices when they move to middle school or when they are offered a variety of foods in environments outside of schools.

Availability and familiarity with fruits and vegetables may not be the only ways of encouraging increased consumption using the school food environment. In hopes of enticing students to eat healthful cafeteria foods, many school nutrition programs are using marketing strategies to help compete with fast-food restaurants. For example, schools are using food courts, portable food and salad bars, more a la carte offerings, and local chefs to improve the visual and taste elements of food (Briggs et al., 2003). Researchers are also examining the potential of creative signage to increase attractiveness and consumption of fruits and vegetables (S. Smith, personal communication, September 18, 2011). APS uses two such strategies by offering salad bars in all schools and using Go, Slow, Whoa signage to identify healthy food options.

Meals and snacks during the school day play an important role in developing children's eating patterns. Even though NSLP dictates nutrient requirements for school lunches, the preparation, quality, and taste of foods offered by individual districts and schools is not monitored at the national level. If schools are offering healthful foods that do not taste good, students are likely throwing away a good portion of the food on their lunch tray. Alternatively, if students are offered lunches that meet the NSLP guidelines but do not include new, healthful recipes with whole and fresh food ingredients, children are unlikely to develop new taste preferences for healthful food. These issues might continue the problems of low-nutrient intake or neophobia (fear of new foods). Using the cafeteria to increase children's consumption of healthful foods is a promising nutrition environment strategy, but one that requires constant evaluation. APS pioneered new healthy recipes in 2011, and this study will help determine if students are reacting positively and developing taste preferences for these healthy foods.

Research on the school food environment shows it to be a positive influence on both low and middle socioeconomic status (SES) student food consumption (Cullen, Watson, & Fithian, 2009). Most low SES students selected the healthful NSLP meal and did not buy many a la carte items. These decisions, most likely due to economic necessity, keep low-income students from purchasing additional a la carte items and enable them to be positively affected by the nutrition environment. When snack bar foods were limited and controlled, middle SES kids also selected the NSLP, thus pointing to the potential influence of the NSLP on nutrient intake when competitive foods are not available for financial or policy reasons (Cullen et al., 2009). Elementary schools in APS do not offer competitive foods, making the nutrition environment equal for all students, regardless of SES. Given the higher risk of obesity for lower SES students, it is important to pay particular attention to the nutrition intervention effects for different SES levels. The national prevalence of childhood obesity for children below the poverty threshold was 27.4% in 2007, or 2.7 times higher than the prevalence for children with family income over 400% of the poverty level (G. K. Singh et al., 2010). Given that 75% of APS elementary school students participate in Free and Reduced Lunch programming, it is important to be sensitive to the impact of SES on nutrition interventions. The High 5 project found that high SES students in intervention schools had the largest FV consumption when compared to control schools, but that middle SES and low SES students in intervention schools still consumed significantly more fruits and vegetables than control schools (Reynolds et al., 2000). The CATCH study, upon which the GSW program is based, compares data by study sites, ethnic groups, and gender, but does not consistently report outcome data for SES groups (Lytle et al., 1996; Perry, Lytle et al., 1998). Although specific SES data will not be obtained for each tray collected in proposed plate waste methods in this study, aggregate free and reduced lunch data (a proxy for SES) is available for each school and will be used to match GSW schools to comparison non-GSW schools.

Social ecological models suggest multiple levels of influence on nutrition behavior. The GSW program and Scratch Cooking Cafeteria Changes in APS offer various intervention strategies at each level of social ecological modeling and influence. Quantitative data collection methods will determine the effectiveness of overall programming (all levels of influence) at improving dietary intake. Qualitative data collection techniques will help qualify quantitative results by determining the inclusion and dose of specific strategies at different social ecological levels.

Other Research on Eating Behaviors, Food Choice, and Nutrition Education

Taste Preference and Food Habits of Children

Prevailing theories of taste preference and food habits support the notion that infants and children prefer specific tastes. Those tastes lead to food patterns and habits in childhood that influence growth and development and future health and chronic disease protection or risk (Nicklas, Webber, Srinivasan, & Berenson, 1993). Food habits that persist throughout childhood and adolescence are more likely to continue into adulthood (Kelder, Perry, Klepp, & Lytle, 1994). Therefore, encouraging the development of preferences for healthful foods in childhood is helpful for creating healthful food habits in adulthood. APS could make a significant impact on lifelong health by encouraging students to develop healthful habits in elementary schools.

Neophobia (fear of new foods) is present in many children, but can be reduced by repeated opportunities to sample new foods. Reducing neophobia requires five to fifteen exposures to new foods (Birch, 1995). If children are continually exposed to high-sugar, high-fat, high-salt foods, those foods will become familiar and children will continue to crave them over more healthy, but less familiar options. Changing nutrition environments in APS to offer more healthful food options for children of young ages will help to make those foods more familiar and possibly more valued by students. When presented with new, whole grain foods, elementary students had favorable responses to the look and taste of whole grain cereal and cheese bread, but were not sure they would want to eat it in a cafeteria lunch (Burgess-Champoux, Marquart, Vickers, & Reicks, 2006). Kids reported that new foods in the cafeteria would be accepted if they looked good, tasted good, and were familiar. Children reported the following tips for introducing new, healthful foods: “If it was healthy, I’d probably hide it, I’d try to make it look like what the other food was. I would just switch it and not tell everybody and let them eat it” (Burgess-Champoux et al., 2006). The challenge to school cafeteria and nutrition services planners in Aurora Public Schools is to make new foods appear familiar enough in appearance and taste or utilize creative marketing or incentive strategies to encourage students to try new foods. Qualitative methods in this research assessed teacher perceptions of whether students realize the foods they are eating are “new” and “healthy” and whether students accept these new foods.

Teaching and Best Practices for Nutrition Education

A recent survey by Action for Healthy Kids reveals that parents think schools are providing nutrition education to all students and they would like such education to be part of the core curriculum two days a week (Action For Healthy Kids, 2005). In reality, kids in the U.S. get an average of 13 hours of nutrition education per year (Celebuski & Farris, 2000; Lytle et al., 1994). Teacher preparation and allotted time for nutrition education are important factors in the quality of information and skills students receive. APS has made nutrition education a priority by allotting increased instruction time for nutrition education in physical education classes.

Nutrition education varies by district, and even more so by schools and classrooms. Classroom teachers, those most often delivering nutrition education, have little training in the topic area because of lack of time and funding and focus on academic core subject instruction. Only about half of elementary school teachers have formal training in nutrition education (Celebuski & Farris, 2000). However, 88% of elementary school teachers reported teaching lessons about nutrition to their students in the 1996-

1997 school year. The mean number of hours spent in a school year on nutrition education by elementary school teachers (K-5) who taught nutrition was 13, below the minimum of 50 hours thought to be necessary for impact on behavior (Celebuski & Farris, 2000; Lytle, 1994). Qualitative methods explored the training and confidence levels of P.E. teachers in APS elementary schools to deliver nutrition education and the GSW program. P.E. teacher interviews included questions regarding amount of time spent preparing for and delivering GSW lessons to document different "doses" of the GSW program offered at different schools. Training for and confidence in teaching, as well as dose/contact hours of GSW programming could have an influential effect on school-level outcomes.

Incorporating nutrition education into classroom instruction with successful learning strategies is an important area of research. One meta-analysis of nutrition education strategies recommends the following for effective nutrition education (Lytle, 1994):

- Instruction with a behavioral focus, or a focus on changing specific behaviors rather than on learning general facts about nutrition;
- Employment of active learning strategies instead of relying exclusively on information dissemination and didactic teaching methods;
- Devotion of adequate time and intensity to nutrition education (at least 50 hours per year to impact attitudes and behavior);
- A family involvement component;
- A meals program and food-related policies that reinforce classroom nutrition education;

- Teachers with adequate training in nutrition education

Other research contributes to best practices for school nutrition education. The CATCH program demonstrated that nutrition education messages for children are successful when they are focused on behavior and supported by the school nutrition programs (Perry, Lytle et al., 1998). Parental and community involvement are important components of successful nutrition education interventions (Nader et al., 1996; Perez-Rodrigo et al., 2001). Staff dealing with school meals should be properly trained, supported and integrated with teaching staff (Fulkerson, French, Story, Snyder, & Paddock, 2002). Based on a meta-analysis of 29 behavioral interventions studying ages two to 18, strategies to reduce unhealthy behaviors (decreasing sedentary behaviors and dietary fat) are more effective than those promoting positive behaviors (increasing physical activity and consumption of fruits and vegetables) (Kamath et al., 2008). Longer duration and more contact hours involved with interventions produce greater benefit to participants. The School Health Education Evaluation, a large evaluation of the effects of health education programming in schools, found that 8 hours of health education could produce large effect sizes in program-specific knowledge and 20 hours could produce large effect sizes in general health education knowledge. However, even after 35 to 50 contact hours, only moderate effect sizes could be achieved in attitudes and behaviors (Connell, Turner, & Mason, 1985). The CATCH intervention involved 15 to 20 contact hours per year over three years for third through fifth graders and resulted in positive eating behavior and physical activity behavior changes but not physiological changes (Luepker et al., 1996). These changes persisted when re-measured in the eighth grade (Nader et al., 1999). The Know Your Body program included 30-50 contact hours to manipulate diet and create positive effects on serum cholesterol and blood pressure (Resnicow et al., 1992; Walter, 1989). Given the high number of content hours necessary for knowledge, attitude, and behavior change, new interventions should plan appropriately to achieve desired results. An important component of this research was a careful analysis of GSW implementation in each school. P.E. teachers were interviewed and asked specific questions about contact hours, learning strategies, school and administrator support, and other aspects of GSW programming. Analysis of GSW implementation also provides important process evaluation information to improve consistency across schools in future programming.

Implementation Issues in Prevention and Education Programs

Continuous delivery of effective interventions is an important component in program success; few interventions are sustained over time regardless of their success during pilot periods (Durlak & DuPre, 2008; E. M. Rogers, 2003). Measuring the implementation of a program is paramount to drawing conclusions about program success. Negative or null results from a program could signify a failure of that program, or they could simply mean that the program was not implemented as designed. Conversely, positive program impact could result from intended implementation or from implementation quite different than what was intended. It is impossible to make judgments about a program without assessing implementation. Implementation data also help to test theory behind an innovation by ascertaining which components and which related theories were effectively administered (Durlak & DuPre, 2008). A meta-analysis by Durlak (2008) defined key terms related to implementation: (1) Fidelity, or the extent to which a program corresponds to the originally intended program, (2) Dosage, or how much of a program has been delivered, and (3) Quality, or how well different program components have been conducted. Regression analyses in one review of 221 school-based prevention programs targeting aggressive behaviors reported that implementation was the most important variable that influenced outcomes (Wilson, Lipsey, & Derzon, 2003). Other studies of school-based interventions and community-based interventions targeting a variety of outcomes found significantly higher effect sizes in programs that monitored implementation and adjusted analyses for factors related to implementation (Ananiadou, Schneider, Smith, & Smith, 2004; Derzon, Sale, Springer, & Brounstein, 2005; D. DuBois, Holloway, Valentine, & Cooper, 2002; Tobler, 2000).

Researchers have historically analyzed implementation in two major ways: (1) categorically, with groups for different levels of implementation (i.e. high vs. low) or (2) continuously, with percentages assessing level of dosage or fidelity (Durlak & DuPre, 2008). The latter method reports a broader range of implementation and might give more statistical power to conclusions about the effects of implementation. The two most common methods for arriving at implementation values are provider self-reports and independent behavioral observations (Durlak & DuPre, 2008). Few studies have directly compared the two strategies, but objective observations would likely return more unbiased, accurate, and comparable assessments of implementation. Including measures of implementation in qualitative and quantitative analyses help predict program outcomes. This research utilized qualitative strategies to assess implementation.

A social ecological framework can be used to identify influences on program implementation. Contextual factors are important in understanding motives, support, and barriers for implementation. Durlak and colleagues identified the following main categories in an ecological framework for program implementation: innovations, individuals and communities, and features associated with the prevention delivery and support systems (2008). The innovation can be defined as the program itself. Program characteristics that affect implementation include adaptability (program flexibility to meet the needs of providers/teachers) and compatibility (contextual appropriateness and fit with the organization/school) (Everett M. Rogers, 2003). Although there must be a balance between adaptability and fidelity of proposed implementation, programs that are adaptable for teachers and that fit within the culture of a school and school district show higher fidelity and quality of implementation.

Factors related to individual providers and communities will affect program implementation. For example, school staff forced to launch a program and school staff who volunteer to create or deliver a program could vary in the effectiveness of their program implementation. Provider/teacher characteristics of implementation include: (1) providers who recognize program need, (2) providers with high self-efficacy for program delivery, (3) providers who have the skills to implement the program, and (4) providers who believe in the program and the potential benefits (Barr, Tubman, Montgomery, & Soza-Vento, 2002; Cooke, 2000; Ringwalt et al., 2003). Supportive principals are also an integral part of high fidelity for program implementation (Kam, Greenberg, & Walls, 2003).

The prevention delivery and support system for providers are key components of implementation. Training and technical assistance for people implementing a new prevention program are key elements of program success. The goals of training should include development of mastery in specific intervention teaching and skills, as well as attention to provider expectations, motivation and sense of self-efficacy (Durlak & DuPre, 2008). After a program begins, technical assistance should help maintain providers' motivation and commitment, improve their skills where needed, and support problem solving efforts. Two studies show that early monitoring of implementation followed promptly by retraining for providers with initial difficulties doubled the fidelity of implementation to over 85% (Dufrene, Duhon, Gilbertson, & Noell, 2005; Greenwood, Tapia, Abbott, & WAlton, 2003). Dialogue and communication with providers is crucial immediately after the beginning of a new program, and remains important throughout the duration of a program.

Summary

According to the American Dietetic Association, about half of all Americans believe they are doing all they can to achieve balanced nutrition and a healthful diet, but given that such a significant portion of our population is overweight or obese, it appears that knowledge alone does not lead to behavior change (American Dietetic Association, 2008). Given that information dissemination is necessary but not sufficient to change behaviors, Contento (2011) recommends that nutrition education focus on personal motivations and competence, interpersonal interactions, and environmental factors that influence individual and community patterns of behavior. Aurora Public Schools are following that recommendation with the Go, Slow, Whoa program to educate students, increase knowledge, and change attitudes and behaviors surrounding nutrition, and the Scratch Cooking initiative to improve the nutrition environment and healthful food offerings in schools. The theoretical basis for this research included SCT and SEM. The constructs of SCT and SEM provide support for intervention components and facilitate knowledge and action by individuals and make the environment more conducive and supportive of desired changes. This research assessed the effectiveness of this educational and ecological combination of Aurora Public School programming for promoting dietary intake and health.

The most similar intervention to the current GSW intervention is the Dietary Intervention Study in Children (DISC): a 3-year intervention aimed at decreasing intake of fat, saturated fat, and cholesterol among pre-adolescent children by increasing knowledge and skills for identifying healthy food (Stevens et al., 1995; Van Horn et al., 2005). The DISC study utilized intervention sessions (number unreported) to teach children how to identify healthy foods (Go foods) to choose and eat all the time and less-healthy foods (Whoa foods) to choose and eat only occasionally. The intervention lessons utilized a “Go-Guide” wheel with eight wedges pertaining to eight categories of a child’s diet. Within each wedge, Go foods were highlighted in green and Whoa foods were highlighted in red. Dietary intake was measured with 24-hour dietary recall at both pre-intervention and post-intervention. Although the intervention sessions in the DISC research targeted a visual nutrition guide very similar to GSW, assessing dietary intake with subjective 24-hour recall is much different than objective visual plate waste analysis used in this research. However, utilizing a 24-hour recall methodology, the intervention group showed increased consumption of Go Foods in all measured food categories except for fruits and those increases were significant for dairy products, desserts, and fats/oils. The intervention group showed decreased Whoa Dairy, Whoa fats/oils, and Whoa vegetables (specifically French fries) when compared with the control group. This nutrition education intervention utilized very similar visual aids and teaching tools as the

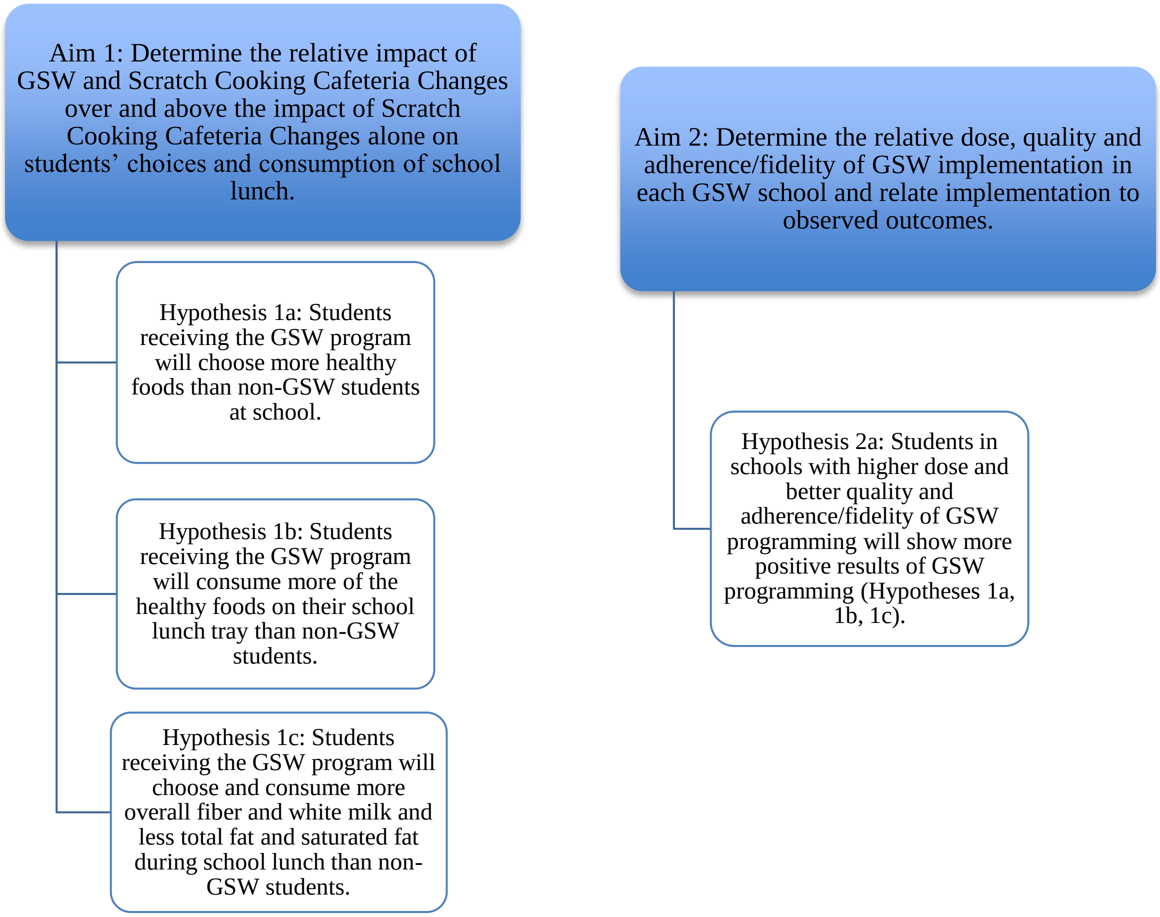
GSW program in Aurora Public Schools. Teaching healthy food identification skills with a Go-Whoa visual aid improved diet quality and leads to hypotheses about the current GSW programming in APS. Given the success of the DISC program, I hypothesize that students in GSW schools with high fidelity, dose, and quality of implementation who received Scratch Cooking Cafeteria Changes will have significantly higher choice and consumption of Go foods than non-GSW schools who only receive Scratch Cooking Cafeteria Changes. Overall, I hypothesize that students in GSW schools will report increased choice and consumption of healthy foods and new healthy recipes in APS cafeterias.

CHAPTER III

METHODS

Research Question and Hypotheses

How influential is the Go, Slow, Whoa nutrition education program combined with Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on elementary students' choices and dietary intake related to healthy foods?



Aim 1: Determine the relative impact of GSW and Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on students' choices and consumption of school lunch.

Hypothesis 1a: Students receiving the GSW program will choose more healthy foods than non-GSW students at school.

Hypothesis 1b: Students receiving the GSW program will consume more of the healthy foods on their school lunch tray than non-GSW students.

Hypothesis 1c: Students receiving the GSW program will choose and consume more overall fiber and white milk and less total fat and saturated fat during school lunch than non-GSW students.

Aim 2: Determine the relative dose, quality and adherence/fidelity of GSW implementation in each GSW school and relate implementation to observed outcomes.

Hypothesis 2a: Students in schools with higher dose and better quality and adherence/fidelity of GSW programming will show more positive results of GSW programming (Hypotheses 1a, 1b, 1c).

Figure 3: Aims and Hypotheses

Research Design

This study employed a quasi-experimental, posttest only, nonequivalent control group design using mixed-methods and focused on outcome evaluation. In this study, the Go, Slow, Whoa program and Scratch Cooking Cafeteria Changes, existing pieces of LiveWell Colorado programming, were in need of outcome evaluation. Outcome, or summative, evaluation focuses on two issues: effect assessment (production of desired effects) and efficiency assessment (benefits in relation to costs) (Singleton & Straits, 2010). The focus of this research was effect assessment of both GSW and Scratch Cooking Cafeteria Changes, which helps in drawing conclusions about efficiency of the programs. Quasi-experimental designs are utilized when legal, ethical, or practical considerations make true experimental design impossible (Singleton & Straits, 2010). In Aurora Public Schools, all schools were exposed to Scratch Cooking Cafeteria Changes in the 2010-2011 school year. Only five elementary schools were exposed to GSW, and these five schools were selected without randomization. Thus, a nonequivalent control group design was chosen to compare schools with GSW to control schools without GSW. Although similarity of schools and students cannot be ensured without randomization, this quasi-experimental design matched experimental and control schools with propensity score and Mahalanobis matching techniques in an attempt to minimize differences between schools on observable characteristics. In this instance, pretest data were not collected by the school district, therefore a posttest-only design offered the best information for determining program effects.

This quasi-experimental, posttest only, nonequivalent control group outcome evaluation research was selected over competing study designs because of existing constraints of the school district and LiveWell programming. Combining quantitative and qualitative data in a methodologically rigorous design returned rich data regarding student behaviors and teacher impressions resulting from school cafeteria changes and nutrition education. This study design was best suited to answer the research questions related to Scratch Cooking Cafeteria Changes and GSW programming.

Background and Target Population

Aurora Public Schools and LiveWell Colorado Programming

Aurora Public Schools

Aurora Public Schools span two counties: Adams and Arapahoe. The average obesity and overweight percentages for all three counties is significantly higher than the Healthy People 2010 goal of 5%. According to 2009 data (COPAN, 2009):

Table 2: Child Obesity Rates in Aurora

County	% obese children (ages 2-14) (95th percentile)	% overweight children (85th-94th percentile)	% children who eat 5 or more servings of fruits and vegetables daily
Arapahoe	11.9%	11.8%	28%
Adams	18.6%	14.3%	26.9%

Data collected from three Aurora elementary schools show even higher rates of obesity and overweight than the general county rates. Body Mass Indices (BMIs) showed 47 percent of students were overweight or obese and 19 percent were obese. Furthermore, BMI analysis in Aurora identified a trend of increasing BMIs as students advance by grade in elementary school (L. Scott, 2010). This trend points to the critical need to prevent weight gain at the elementary school level. This school district is an excellent target for healthful eating education, promotion, and programming.

Scratch Cooking Cafeteria Changes in Aurora

As of April 2012 in Aurora Public Schools, 53 school food service managers and central office leadership staff had attended the LWC and the Colorado Health Foundation sponsored Cook for America® Culinary School Food Boot Camp. This represents 16% of the total Nutrition Services Staff (kitchen managers, kitchen staff, and central office leadership and staff). The culinary boot camps teach necessary "scratch cooking" skills to increase the use of whole grains, utilize more fresh fruits and vegetables, prepare raw meat instead of reheating frozen and processed meats, and use knives with proper knife skills to increase control over the healthfulness of ingredients. Following the boot camps and prior to the 2011-2012 school year, Aurora Public Schools Nutrition Services Department made significant changes to their menu selection and recipes. Forty-one new recipes utilized by all Aurora Public Schools were developed or modified minimizing added fat, sodium and sugar. APS has incorporated "stealth health" in many recipes by adding healthful foods and ingredients that the students might not even detect (i.e. fresh carrots, zucchini, onions, celery, and garlic in spaghetti/red sauce). APS began offering a salad bar at most schools in Fall 2011. In September, 2011, Aurora Public Schools served over 220,000 lunches in 30 elementary schools, averaging 459 lunches per school.

Although foods consumed and likability of cafeteria offerings were not assessed before APS implemented broad menu changes, post-test only assessment of what kids eat and what kids do not eat will help with APS Nutrition Services planning, program evaluation, and food ordering.

The Go, Slow, Whoa Program

Aurora Public Schools piloted the Go, Slow, Whoa program in one school in Spring 2010. After analyzing pre-post surveys from students in the program as well as interviewing program managers, the program was expanded to five elementary schools for the 2010-2011 school year. All elementary schools are slated to receive the program by the 2014-2015 school year.

The Go, Slow, Whoa Program was developed as a component of the Coordinated Approach to Child Health (CATCH program) at the University of Texas School of Public Health at Houston and adopted as a part of the National Heart, Lung and Blood Institute WECAN! program to help kids identify healthy foods in school meals and at home (NHLBI, 2009; Perry, Bishop et al., 1998; Perry et al., 1997). Using a green light, yellow light, red light visual aid, students are taught how to incorporate more healthy foods into their diets. *Go* foods, or more nutrient dense foods, should be consumed more often than *Slow* or *Whoa* foods that have added fat and sugar. *Slow foods* should be eaten less often and in smaller quantities. *Whoa foods* should be eaten only rarely.

GSW, in Aurora Public School District, utilizes a kick-off assembly, physical education class time, parent meetings, classroom teacher reinforcement, and cafeteria food labeling to educate about and reinforce the consumption of Go foods. In late September, 2011, each of the five GSW elementary schools hosted a kick-off GSW assembly featuring the P.E. teacher, a TV personality from Channel 7, and several mascots in costume (Power Panther and the Colorado Avalanche mascot). The assembly reinforced the proper identification of Go, Slow, and Whoa foods, introduced kids to the cafeteria labeling system, and served as a cheerleading session for the program. In

October, parents were invited to attend either a parent breakfast or a parent afternoon snack meeting to describe the program and encourage family participation at home. Parents receive monthly newsletters and menus with Go, Slow, and Whoa foods highlighted. The newsletters are created and managed by each individual GSW school, and, therefore, differ across schools.

At the beginning of the 2011-2012 school year the APS Healthy Schools Coordinator held trainings for all principals, gym teachers, nurses, and cafeteria managers from the GSW schools to explain program components and how to implement them according to LiveWell and APS standards. Program components are listed in Table 3. The nutrition education components of the program are taught and reinforced in P.E. classes as well as in homeroom classrooms. Students are encouraged by teachers and parents to look at the menu and cafeteria labels and choose Go foods on a daily basis. The Nutrition Services Department in the school district label all foods on the school menus (received by all APS families) and daily in the GSW school cafeterias themselves as either Go (green apple), Slow (yellow circle), or Whoa (red square). See Appendix A for a copy of the December 2011 menu and Appendix B for a copy of the rating system for GSW foods (Coordinated Approach to Child Health (CATCH), 2012). It is important to note that the CATCH rating system is for individual food items such as whole wheat bread, fresh tomatoes, 2% cheese, and butter, which would each be labeled as Go, Go, Slow, and Whoa foods, respectively. However, APS Nutrition Services staff label complete menu items in the cafeterias and on print menus. Therefore, taking into account each of those ingredients, a grilled cheese sandwich made with whole wheat bread, 2% cheese, tomato slices, and a small amount of butter would likely be labeled as a Slow food. An important element of the GSW program is point-of-sale labeling of GSW foods. Kitchen managers set out labels in acrylic frames each day above or beside food options identifying food items as Go, Slow, or Whoa.

Incentive days allow nutrition services and school personnel to promote healthy foods and the GSW program. Three incentive days are offered during the school year to each GSW school during which a special fruit, vegetable, or skim milk is offered. If students take AND eat the item they receive a Channel 7 wristband (similar to Lance Armstrong's Live Strong bands). The bands come in three different colors, thus a new color is offered on each incentive day.

Table 3: GSW Program Components

Program Component	**Program Component Description**	**Responsible Party** (note: there is no mandate as to who completes different components. This column is based on qualitative interviews and informal observations.)
Nutrition Education/GSW Curriculum	Lessons to teach and reinforce the Go, Slow, Whoa labeling system	P.E. Teachers, Cafeteria Managers
Kick Off Assembly	Assembly to introduce GSW, increase energy, awareness, and excitement.	District GSW Administrators, Principals, P.E. Teachers, Cafeteria Managers, Channel 7 News Personalities
GSW Labels on Lunch Menus	Encouragement and assistance for students to look for GSW labels on printed lunch menus	Classroom Teachers, P.E. Teachers, Parents, Cafeteria Staff
Labeling of Cafeteria Food with GSW Labels	GSW labels affixed to plastic sneeze guard or in front of lunch items each day.	Cafeteria Staff
Three Incentive Days	Prizes (bracelets) awarded if students take/consume a certain product (white milk, specific fruit, specific vegetable) on three days during the school year	Cafeteria Staff, Lunch Room Aides, Administrators
Parent Breakfast	Informational meeting about GSW	Principal, Assistant Principal, Cafeteria Manager
GSW Articles in School Newsletters	Newsletters to entire school community should contain GSW information or nutrition-related articles	P.E. Teachers, Front Office
Extra Programming	Guest Speakers, More Incentive Days	P.E. Teachers

Methods for Matching GSW Schools with Comparison Schools

Five schools were selected for participation in the GSW program in the 2011-2012 school year. All schools will implement the GSW program by 2014-2015. The procedure for placing schools on the rotating start list was not random, nor was the selection process documented. Seven schools participated in GSW programming in 2010-2011 and five elementary schools started in fall 2011. Given that schools were not selected randomly for treatment in the 2011-2012 school year, propensity score matching was an appropriate statistical technique to identify five schools most similar to the GSW schools on observed school characteristics to serve as comparison schools.

Propensity score matching allows researchers to determine the extent to which a treatment group and comparison group is similar based on some observed covariates, even when the groups are assigned without randomization. The goal of propensity score matching is to match experimental and control subjects on observed covariates so that the main difference between them is whether or not they received the treatment (Khandker, Koolwal, & Samad, 2010; Rosenbaum & Rubin, 1983). Propensity scores reduce all of the observed covariates into a numerical, scalar summary for selecting matched samples: the probability of receiving the treatment (ranging from 0 to 1), conditional on the covariates. Matching can then be done on this scalar summary rather than on all of the covariates directly (Rosenbaum & Rubin, 1983). The premise behind this technique is that if two units have the same propensity score but are in different treatment groups, the determination of which unit received treatment and which did not was random based on observables. Therefore, in the school-level setting, treatment and comparison schools with similar propensity scores should have similar joint distributions of the covariates used for propensity score matching. Treatment effects can then be estimated based on the mean differences in outcomes between participants and matched non-participants. In this particular research, schools were treated as matching units because entire schools were selected to receive treatment.

> Matching methods such as propensity score matching are becoming more and more popular as ways to estimate causal effects by using observational data. These methods, which select subsets of the original treatment and control units that are the most similar on the observed covariates, can be conceived as a way to replicate a randomized experiment by selecting treatment and control units (schools) that look only randomly different from one another on all of the observed covariates (Stuart, 2007).

Oftentimes observational studies simply utilize models with a treatment indicator and a set of covariates as predictors of some outcome variable. Instead, the design of observational studies can be structured with the rigor of randomized experiments: without using the outcome data and with a good understanding of the treatment and control conditions (Rubin, 2001). This approach involves outlining the extent to which the treatment and comparison groups are similar on background covariates and then using methods such as propensity score matching to ensure that the treatment effects are estimated by using schools or subjects that look similar to each other. The strongly ignorable treatment assumption (SITA), a key assumption of propensity score matching, implies that treatment assignment is independent of the potential outcomes given the observed covariates (Rosenbaum & Rubin, 1983). SITA is met if treatment assignment (Z_i) and the potential outcomes $Y_i = (Y_{0i}, Y_{1i})$ are conditionally independent given the observed covariates X_i (or, alternatively, the propensity score). The formula for this probability of treatment assignment is:

$$\Pr(Z_i|X_i,Y_i) = \Pr(Z_i|X_i), \text{ with } 0 < \Pr(Z_i = 1|X_i) < 1,$$

where Y_{0i} is the potential comparison outcome (for $Z_i = 0$) and Y_{1i} the potential treatment outcome (for $Z_i = 1$) for all subjects $i = 1,\ldots, N$. These outcomes are called potential outcomes because they refer to the outcome one would observe if subject i gets treated (Y_{1i}) or not treated (Y_{0i}) (Shadish & Steiner, 2010).

There are several advantages of Propensity Score Matching (PSM)(Khandker et al., 2010). PSM provides good comparisons if observed characteristics drive program participation and unobserved characteristics are negligible. PSM does not require a baseline survey or data. PSM is a semi-parametric method, imposing fewer constraints on the functional form of the treatment model, as well as fewer assumptions about the distribution of the error term. This means that PSM increases the likelihood of sensible comparisons across treated and matched control units.

The information that was available for all public elementary schools in Aurora is summarized in Table 4. This study used various propensity score models with some and all of these covariates to determine the best fitting model.

Table 4: Covariates for Matching

Variable	Definition
Race/Ethnicity	% of students in each school who are: White – omitted from model as comparison group Black Asian Hispanic Native American Native Hawaiian Two or More Race/Ethnicities
Free/ Reduced Lunch (FRL)	% of students in each school who are eligible for free or reduced lunch. Governmental program that provides low-income students with free or reduced price school meals. Percentages for schools are determined by taking the number of students eligible for free or reduced price lunch divided by the total number of students enrolled in the school.
Gifted and Talented (GT)	% of students in each school who are gifted and talented in either math or language or both. They are identified by teachers as they search for students who perform at exceptional levels. Nominations for GT students are made with supporting evidence from cognitive and culture free measures, academic aptitude and performance, language acquisition skills, etc.)
Special Education (SPED)	% of students in each school who are classified as special education and have an individualized education plan (IEP).
English Language Learners (ELL)	% of students in each school who are classified as English Language Learners (either no proficiency or low proficiency in English)
Nutrition Programs (NP)	Total Number of additional Nutrition Programs offered in a school (Range 0-5) The five possible programs offered at various Aurora schools are: Breakfast in the Classroom Fresh Fruit and Vegetable Program INEP Nutrition Education Healthier U.S. Schools Challenge Award for implemented changes and activity time (not necessarily a program, but a commendation for changes) Coordinated School Health.

The Nutrition Programs variable was created as a sum of additional nutrition programs offered in a school. This variable was created by combining 5 different dichotomous variables (for each of five programs) to save degrees of freedom in modeling. The logic of including the Nutrition Program variable relates to the ability and motivation of each school to bring in additional nutrition programs. If a school (administrators, teachers, and/or parents) is able to bring in 3 additional programs, that school is likely different in various ways (motivation of school community, SES of children, previous grant funding) compared to a school that does not bring in any additional program.

Propensity scores were calculated in STATA using the PSMATCH2 program which runs multiple methods of matching using propensity scores and full Mahalanobis matching (Leuven & Sianesi, 2003). Propensity scores were estimated with a logit model using two different matching methods: nearest neighbor matching and Mahalanobis matching. These two matching methods were chosen because of the small sample size and based on previous research with Mahalanobis matching and smaller sample sizes (Zhao, 2004). Nearest-neighbor matching randomly orders the treatment schools, and then finds a control school with the closest propensity score (D'Agostino, 1998). Because of the small sample size of untreated schools, those two schools were then taken out of the pool (not replaced) and the second treatment school was matched with the nearest neighbor in terms of propensity score.

The second method used for matching was Mahalanobis metric matching combined with propensity score matching. This method randomly ordered subjects and then calculated the distance between the first treated subject and all controls using matching variables (including the propensity score) and the sample covariance matrix of matching variables from the full set of control subjects (Baser, 2006; D'Agostino, 1998). The first randomly ordered treatment subject was matched based on the smallest Mahalanobis distance. The process was then repeated until each treatment subject received a match.

In this research, propensity score matching was based on data available for all elementary schools included in Table 4: (See Appendix C for complete Data Table.). Running 12 different logit models helped determine the best fitting models for the available data. As indicated in the literature, different variables were logged and squared in different models to determine improvements in the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Different variables (12 total) were included and excluded in successive models to determine improvements in model fit. Models with fewer covariates improved AIC and BIC values. Even though none of the individual independent variable coefficients were significant in any of the models (perhaps due to small sample size), three models emerged with very similar AIC and BIC values. Using fewer covariates in these three models with such a small pool of available matches helped to avoid overspecification of matching models. Post-hoc analyses of variable means show the differences between covariates (mean values) for treatment schools and match schools. Model 1 used propensity score matching with four covariates and nearest-neighbor matching. All variables with large mean differences between matches were logged and run in different models to determine the best fitting model. Logging the Hispanic variable resulted in lower AIC and BIC values, and thus this variable is logged in Model 2. Model 2 used propensity score matching with four covariates (1 logged) and nearest-neighbor matching. Model 3 used full Mahalanobis matching with five covariates (the covariates in Model 2 plus propensity scores).

Formulae for Propensity Score and Mahalanobis Metric Logit Models:

Model 1: Propensity Score Matching

Y (GSW treatment inclusion) = α (intercept) + b_1X_1 (percentage Hispanic students) + b_2X_2 (percentage English Language Learner Students) + b_3X_3 (percentage Free and Reduced Lunch Students) + b_4X_4 (Number of Nutrition Programs) + ε

Model 2: Propensity Score Matching
Y (GSW treatment inclusion) = α (intercept) + b_1X_1 (logged percentage Hispanic students) + b_2X_2 (percentage English Language Learner Students) + b_3X_3 (percentage Free and Reduced Lunch Students) + b_4X_4 (Number of Nutrition Programs) + ε

Model 3: Mahalanobis Matching

Y (GSW treatment inclusion) = α (intercept) + b_1X_1 (logged percentage Hispanic students) + b_2X_2 (percentage English Language Learner Students) + b_3X_3 (percentage Free and Reduced Lunch Students) + b_4X_4 (Number of Nutrition Programs) + ε + b_5X_5(Propensity Score) + ε

Results of all three matching models using the Stata PSMATCH2 program (Leuven & Sianesi, 2003), are shown in Figure 4.

Model	Log Likelihood (null)	Log Likelihood (model)	AIC	BIC
Model 1 Propensity Scores	-12.51	-12.20	34.40	40.49
Model 2 Propensity Scores	-12.51	-12.05	34.09	40.20
Model 3 Mahalanobis Matching	-12.51	-12.05	34.09	40.20

Figure 4: Matching Model Results

Model 3 (Mahalanobis matching) produces similar model statistics to Model 2 (Propensity Score matching), because Model 3 was calculated with the same predictor variables as Model 2. Therefore, the propensity scores are identical for both models. However, the comparison schools chosen by Model 3 are different because Mahalanobis matching uses the propensity scores as an additional matching variable.

The STATA PSMATCH 2 program determined the following matches for each GSW school for each of the three models.

Table 5: Matched Schools Based on Three Matching Models

GSW School	Model 1 Match	Model 2 Match	Model 3 Match
Altura	Wheeling	Peoria	Wheeling
Lansing	Yale	Fulton	Jewell
Vistapeak	Sixth Avenue	Yale	Arkansas
Crawford	Murphy Creek	Sable	Fletcher
Vassar	Dartmouth	Dartmouth	Dartmouth

The following figures (Figures 5-9) show the absolute values of covariate differences between GSW schools and their matches for each model. These figures provide a visual of how similar the GSW schools were to their matches on each matching variable using 3 different Models. If the y-axis values in any of the following graphs are zero, then there is zero difference between the GSW school and the match school on that covariate.

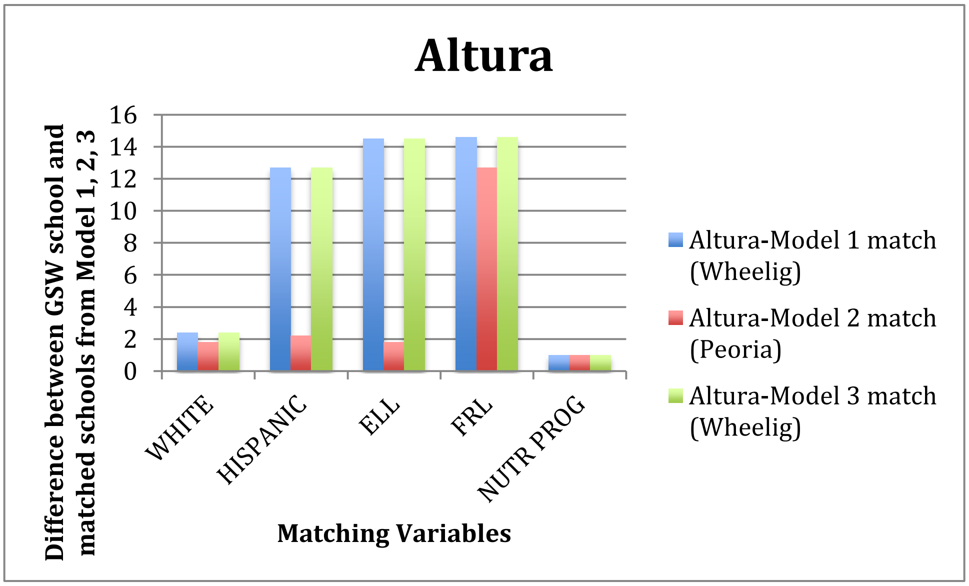


Figure 5: Altura Matching Results

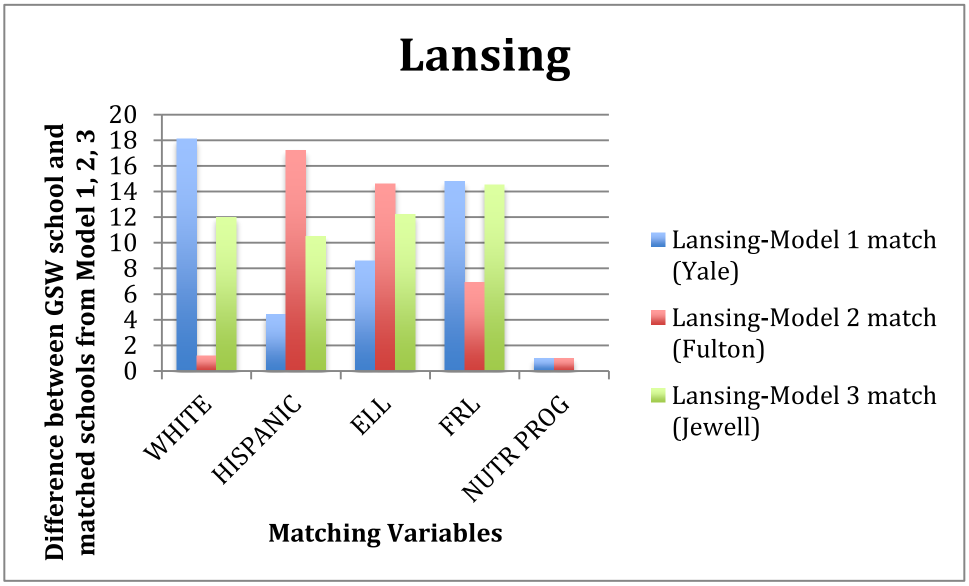


Figure 6: Lansing Matching Results

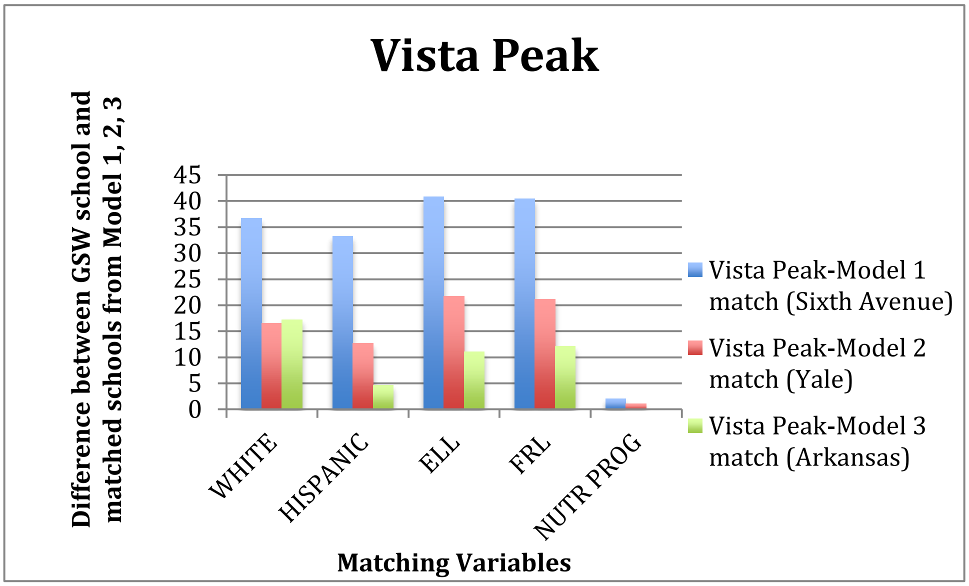


Figure 7: Vista Peak Matching Results

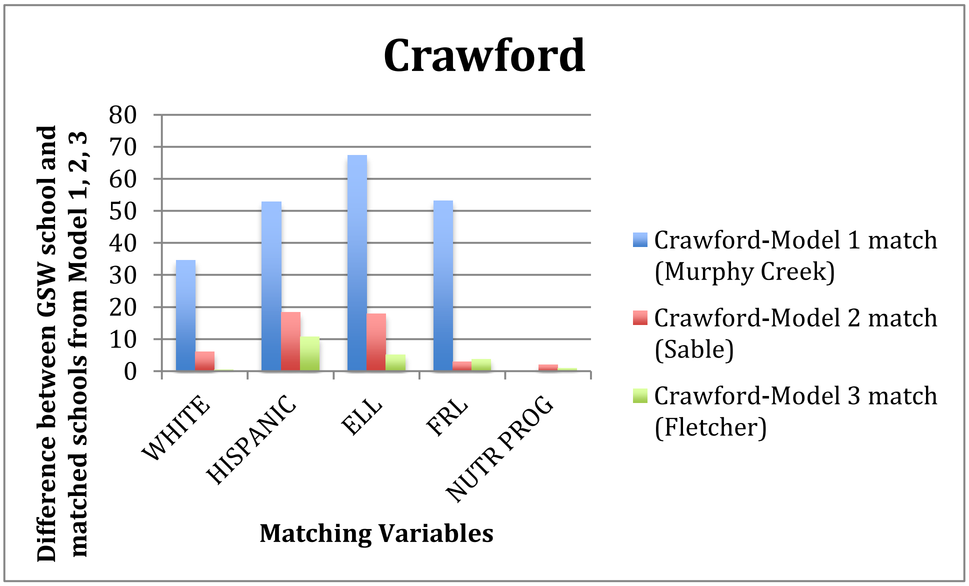


Figure 8: Crawford Matching Results

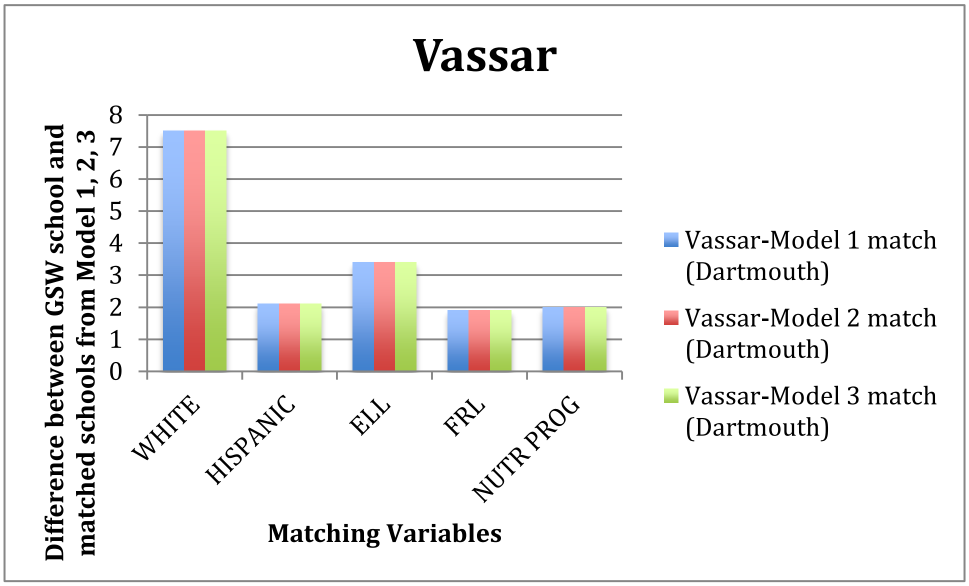


Figure 9: Vassar Matching Results

Visual inspection of the differences in means between GSW schools and their matches using Models 1, 2, and 3 indicated that Model 3 (Mahalanobis Matching with Propensity Scores) had the smallest differences on the most number of covariates. “Smallest differences” between schools on covariates simply meant those schools were most similar on that covariate. For example, in looking at the covariate *White (percentage of White students in the school)* in Figure 5, the difference between Altura and the Model 2 match (Peoria) is the smallest (shaded red), and therefore, Model 2 is the best match for that particular covariate. There were 5 covariates for each school. Multiplying 5 covariates by 5 schools resulted in 25 different variable combinations to be considered in the best fitting model across all schools. Totaling which model (Model 1, Model 2, or Model 3) produced the smallest difference between the GSW School and Match School on each of the variables is summarized in Table 6.

Table 6: Comparison of Matching Models for Best Fit

	Model 1	Model 2	Model 3
Number of variables in which the model produced the best match	9	12	16

*note that the total number of variables in this table does not total 25. If a variable resulted in the same lowest differences between GSW school and Match school for more than one Model, then both models were counted in this table.

Because it produced the greatest number of smallest differences between match school means and GSW school means, Model 3 (Mahalanobis Matching with Propensity Scores) was used to identify untreated comparison schools for the GSW treatment schools. Final school matches are listed in Table 7.

Table 7: Final Comparison Schools

GSW School	Model 3 Match
Altura	Wheeling
Lansing	Jewell
Vista Peak	Arkansas
Crawford	Fletcher
Vassar	Dartmouth

Data Collection Methods

Aim 1: Quantitative Plate Waste Data

Aim 1: Determine the relative impact of GSW and Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on students’ choices and consumption of school lunch.

This research utilized both quantitative and qualitative data collection methods. Identifying what children choose and what they eat at school helped address the research questions. Children, especially young children, are oftentimes omitted from data collection in schools because of their underdeveloped reading skills and variation in cognitive skills and development (J. Scott, 2008). This study used quantitative data collection that did not require reading on the part of the students in grades 1, 3, and 5. Grades 1, 3, and 5 were chosen for data collection to represent the range of ages and grades in an elementary school without collecting data from all grades.

Dietary intake using quantitative survey methodology, while providing some useful information based on personal food recall, does not always produce reliable results (Beaton, Burema, & Ritenbaugh, 1997; Tran, Johnson, Soultanakis, & Matthews, 2000). Children and adolescents, specifically, do not accurately recall food intake, which becomes a problem when such assessments are used to monitor nutritional status

(Livingstone, Robson, & Wallace, 2004). Children under-report, over-report, and incorrectly identify foods and portion sizes. A meta-analysis of 11 studies using food recall surveys with children found a wide range in mean energy intake and validity of food recall techniques (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000). Food diaries/records are another subset of food recall techniques commonly used to eliminate issues with memory, but they do not eliminate issues related to estimating portion size and properly identifying foods consumed. Validity and reliability of food diaries/records is not consistent in multiple studies using this technique (McPherson et al., 2000). Therefore, the quantitative method selected for this study assessed plate waste, an accurate assessment of food intake for a specified time period that did not involve individual subjective reporting. In order to assess the effect of GSW and Scratch Cooking Cafeteria Changes on students in grades 1, 3, and 5, plate waste methodology was selected considering the varying cognitive abilities of children ages 5-11.

The most accurate way to measure food intake is weighing foods before and after consumption (Wolper, Heshka, & Heymsfield, 1995). However, this method is time consuming and costly. Using “plate waste” or the quantity/weight of food left after a food is consumed has been utilized to assess the National School Lunch and School Breakfast programs. Given the importance of good data concerning dietary intake in children, researchers developed other reliable and valid methods for collecting data that are less costly and less intrusive. Plate waste protocols based on direct visual observation of foods before and after a meal is well suited to cafeteria settings or other public eating situations (Comstock, St Pierre, & Mackiernan, 1981; Wolper et al., 1995). The portion of food that remains (plate waste) is estimated by visual observation when a tray is returned at the end of a meal. Visual estimation of plate waste is a promising and inexpensive technique for assessing dietary intake.

Original visual estimation plate waste studies utilized trained observers directly observing food trays before and after eating. The observers estimated portion sizes for each food in reference to standard portion sizes using some sort of percentage rating scale. By weighing several samples of the reference food (to get accurate baseline serving sizes and nutrition information) and comparing them to the percentage of food left over, the percentage of food eaten (along with weight, energy, nutrients) can be estimated from the average reference food weight and nutrition information. This visual method has been used extensively in studies of nutrient intake and eating behaviors in schools and other institutional settings (Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1999; Davidson, Hayek, & Altschul, 1986; Friedman & Hurd-Crixell, 1999). Direct visual estimation has been proven comparable to weighed protocols in several studies (Comstock et al., 1981; S. Dubois, 1990; Kirks & Wolff, 1985).

One of the barriers to using direct visual estimation in a school cafeteria environment is the required time for food tray assessment. Observing food trays at the end of a lunch line before a student sits down to eat takes precious minutes away from food consumption time. At the end of the lunch period, collecting a large sample of trays necessitates on-site estimation to avoid transportation, sanitation, time, space, and manpower considerations of transporting food trays. On-site post-lunch estimation in a timely manner is difficult due to utilization of cafeteria space for other activities following lunch. Without a large number of data collectors, visual estimation would likely take a long period of time, even for a random sample of trays. It is also difficult to conduct inter-rater reliability assessments if trays are subsequently discarded after post-lunch waste estimation.

A more recently developed method avoids some of these problems by taking a digital photograph of cafeteria trays both before and after food is consumed. The digital photograph is stored for future visual estimation, and can be rated by several trained researchers to ensure data quality. The digital plate waste photography method, utilized successfully with both adults and children, enables reliable and valid data collection for a fraction of the cost of weighed plate waste estimates (Swanson, 2008; Williamson et al., 2003). This study utilized a slightly different method where data collectors recorded on an index card what was on student trays at the end of a lunch line. That record was then used as the pre-consumption data, and a digital photograph of each tray at the end of the lunch period was compared to the pre-consumption data to determine plate waste and food consumption. This modified digital plate waste protocol was developed to avoid delays in lunch lines and reduced eating time resulting from the time required for pre-consumption photographs (S. Smith, personal communication, September 18, 2011).

Sampling Frame for Quantitative Data:

In Aurora Public Elementary Schools, there are 12,800 students. Five schools implemented GSW programming in 2010-2011, and 20 schools were eligible to be match schools because they had not yet received any GSW training or materials. Five GSW schools and five match schools were included in the quantitative portion of this study. Research Assistants aimed to collect twenty cafeteria trays from each of three grades (1, 3, and 5) in each school for three consecutive days. Therefore, in total, 1800 trays were targeted for collection and photographing (20 trays per grade x 3 grades x 10 schools x 3 days). This sampling strategy would return 900 trays from GSW schools and 900 trays from non-GSW comparison schools. We targeted 50% males and 50% females (900 males and 900 females) and 33% from each grade (600 1st Graders, 600 3rd graders, 600 5th graders).

Quantitative Data Collection Process

Because data were collected in 10 different schools on the same day for three consecutive days, over 100 Research Assistants (RAs) (4 volunteers per school/per day) were utilized. These RAs were Kaiser Permanente employees participating in a work-related volunteer program, University of Colorado Denver graduate and undergraduate students, University of Colorado Colorado Springs undergraduate students, and LiveWell Colorado Volunteers. One lead RA for each school was trained in research protocols during a 2-hour training. These lead RAs were present in the same school for all three days and trained all other RAs at that school.

Supplies Used

From School

Spider Cart with removable large sheet trays
3’x4’ or larger rectangular table

From Data Collection Team

Digital cameras with extra batteries (each school had a different memory card for all data collection days)
1 tripod
Base Board (a board made out of plywood shows placement of tripod and trays for photographing)

Ziplocs (to bag random samples for weighing)

Wet wipes

Protractor

Latex gloves

Paper towels

Masking tape

Sharpie markers (for marking tray cards)

Cooler – to transport 5 samples of each food

3 clipboards – note: for ease and efficiency, pre-tear 2-inch pieces of masking tape and affix to the clipboard around the perimeter. These tape pieces were used to tape fluorescent cards to student trays.

Fluorescent Tray Cards –75 for each day with correct lunch offerings printed on card.

Used at CU Denver

Digital Scale - Ohaus Scout Pro SP401 Portable Digital Gram Scale

APS menu planning and nutritional analysis software

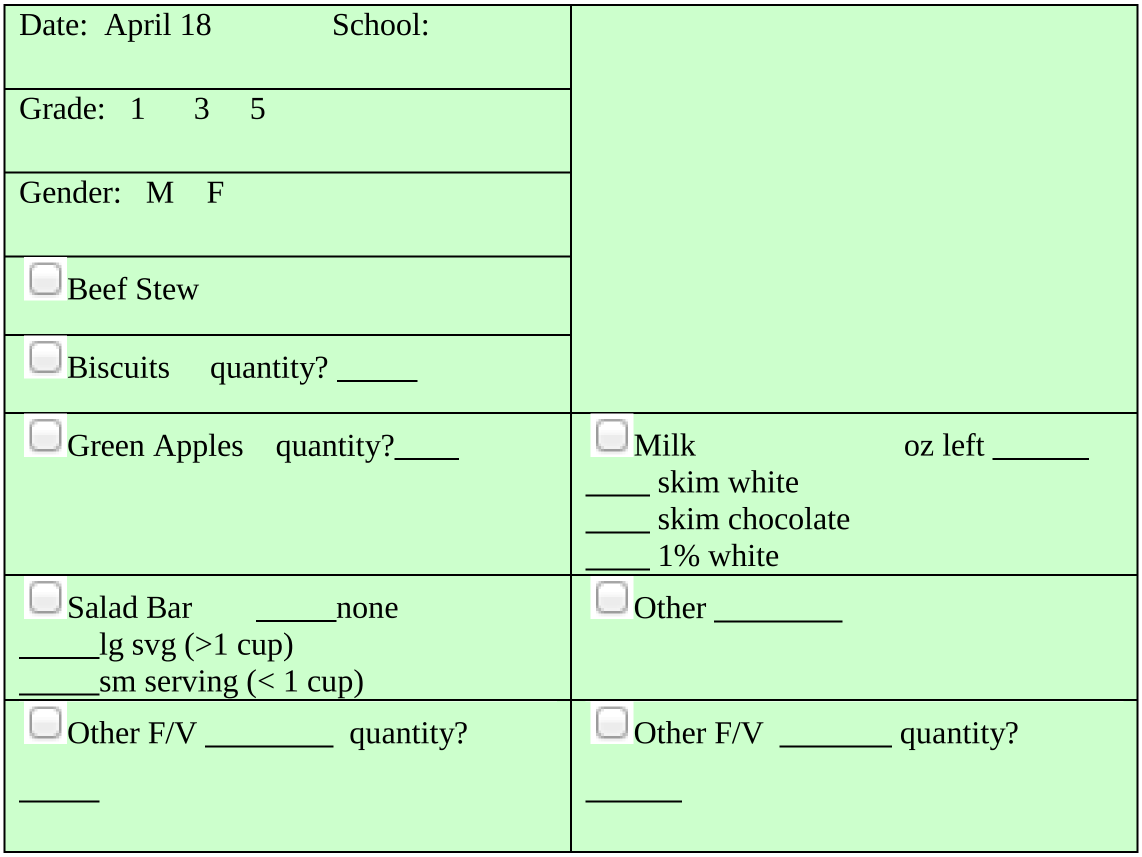
Plate Waste Protocols

Each elementary school separates lunch periods by grade. For statistical power, we needed 20 trays per lunch period per grade (1, 3, and 5). Given the potential loss of tray cards (students hiding tray cards or throwing away cards before RAs could catch them) and malfunction with photography equipment, we aimed to collect 28 trays per lunch period per grade (1, 3, and 5). RAs attempted to alternate between male and female students, although this was not always possible as clusters of same-gender students often came through the line together.

Four research assistants arrived 30 minutes prior to the first lunch period to set up. Each of the cafeterias had a different flow, but the main data collection protocol was the same. The research assistants arranged trash cans in a central spot and positioned a spider cart with removable trays near those trash cans to collect trays/plate waste. RAs set up a table for photography in a less-traveled area of the cafeteria. Upon this table RAs placed the BaseBoard (elevated 2 inches using a 2-inch binder at the end where food trays will be placed), tripod, and camera. Two RAs positioned themselves near the end of the lunch line(s) with clipboards and fluorescent lunch tagging cards. One RA randomly selected the 4th boy to exit the lunch line. The other RA randomly selected the 4th girl to exit the lunch line. The RAs explained the purpose of the study and gave students the opportunity to refuse participation.

"Hi, we are from the University of Colorado Denver and we are doing a study on what kids like to eat in the cafeteria. Would it be OK if we collect your tray at the end of the lunch period?" Wait for answer. If yes, "Great! Thank you very much. Don't throw your tray out at the end of lunch, just put it on that cart over there or give it to one of those two people standing near the cart." If no, "That's OK, enjoy your lunch."

If the student agreed to participate, the RA quickly checked off the pre-portioned (main entrée and side items) or selected (salad bar fruits and veggies) items on the tray using a florescent card (see example below).



Date: April 18 School:	
Grade: 1 3 5	
Gender: M F	
☐ Beef Stew	
☐ Biscuits quantity? _____	
☐ Green Apples quantity?____	☐ Milk oz left ______ ____ skim white ____ skim chocolate ____ 1% white
☐ Salad Bar _____none _____lg svg (>1 cup) _____sm serving (< 1 cup)	☐ Other ________
☐ Other F/V ________ quantity? _____	☐ Other F/V _______ quantity? ______

Figure 10: Tray Cards for Quantitative Plate Waste Data Collection

The RAs then taped the completed card to the student's tray in order to identify participant trays at the end of lunch. This interaction with the student took less than 30 seconds. After an RA affixed the florescent card to a tray, he or she took the next available student. RAs attempted to alternate between male and female students. The other two RAs positioned themselves near the garbage cans and began scanning trays for florescent cards as students finished lunch and walked towards the trashcans. They took participant trays and racked them on Spider Trays (tall rolling carts with room for stacking trays). When the RAs at the end of the lunch line finished flagging 28 students (approximately 14 males and 14 females) during a lunch period (usually 20-30 minute periods), they joined the RAs near the trashcans to receive finished trays. Depending on the flow of the cafeteria and the number of students, some RAs were able to begin the arranging and tray photographing process at this point.

Photographing Trays

Research assistants set up a photography area set apart from the main cafeteria activity and trashcan chaos. That area contained a table, baseboard, tripod, and digital camera (Nikon Coolpix L24). The tripod was set 26 inches above the table and angled down on the tray at 45-degrees (protractor included in supply list). Prior to photographing the tray, RAs placed two letters (corresponding to the first two letters of the school) and a number (numbers began with 1 on the first data collection day, 200 on the second data collection day, and 300 on the third data collection day) on each fluorescent card so that trays/cards were photographed in a numerical order. RAs then poured any remaining milk into a measuring cup and recorded the ounces remaining to the nearest ½ ounce on the florescent card. RAs rearranged food on the tray to make it more clear how much of each lunch item was consumed. For example, if a student placed his or her leftover hamburger over the carrot sticks, RAs moved the hamburger to the side and arranged the carrot sticks so the photo clearly showed the leftover hamburger and how many carrot sticks remain. Finally, the RA took one photo of the tray with the florescent card still attached to it. The florescent card was then collected and all waste thrown in the trash.

In addition to photographing all participant trays, RAs also photographed and collected three sample lunch trays for lab weighing. The weights of these three lunch trays (and all items on that tray) were averaged and used as the comparison serving size for all post-lunch plate waste. Thus, if the average cheeseburger (from those 3 samples) was 5.5 ounces, then all plate waste from that particular school was compared to a pre-lunch tray containing a 5.5-ounce cheeseburger (and nutrients associated with a 5.5-ounce cheeseburger).

Aim 2: Qualitative Interview Data Collection

Aim 2: Determine the relative dose, quality and adherence/fidelity of GSW implementation in each GSW school and relate implementation to observed outcomes.

Qualitative data were collected from semi-structured interviews with physical education teachers in GSW schools to gather data on program implementation, impact, and effectiveness. P.E. teachers are responsible for delivering and reinforcing much of the GSW curriculum. Individual semi-structured interviews were chosen to encourage honest communication about the quality of GSW program materials and curriculum, support and assistance from school and district administrators, and individual teacher enthusiasm for and cooperation with the GSW program goals. Interviews were chosen to elicit complete responses, encourage depth of responses, and determine relative emphasis on issues. Interviews were chosen over focus groups because focus groups are less appropriate for these outcomes given that members might not share the same emphasis on topics and because the group dynamics may imply ideas or emphases that are misleading (Harrell & Bradley, 2009).

Qualitative Data Collection Process

Seventeen eligible physical education teachers were contacted by email in October 2012. Follow-up emails were sent each week until December 1 to all teachers who did not reply to emails. Seven physical education teachers agreed to participate in 30-45 minute individual interviews. Interviews were conducted in November and

December 2012 with teachers in year 1 (3 teachers), year 2 (1 teacher), or year 3 of GSW implementation (3 teachers). There were 17 teachers eligible to be interviewed for their GSW participation: three had left the district and 7 declined participation or did not answer emails. Interviews were conducted at convenient times for teachers at their individual schools. Semi-structured interviews were conducted using the interview guide shown in Appendix D. Interviews were recorded and transcribed.

Informal observations were also recorded when researchers were present in the schools. The lead data collector at each school filled out the field notes sheet each day of data collection. These observations were recorded in field notes and included descriptions of observed interactions in cafeterias, visual aids posted on school walls, comments from conversations with school staff, available foods in salad bars, etc. Unstructured field notes are another qualitative technique used to collect important data(Mulhall, 2003). Field notes were recorded on the field notes sheet shown in Appendix E.

Analyses

Quantitative Plate Waste Analysis: Aim 1

The average weight of each food was determined by weighing the three samples from each cafeteria with a digital scale. Nutrition information for each food was assessed with Vboss software (http://www.horizon-boss.com/) utilized by Aurora Public Schools Nutrition Services. This software package encompasses menu planning, ordering, recipes, nutrition, accounting, point-of-sale, online payments, free and reduced lunch management, and more. The menu planning, recipe, and nutrition analysis features of the software provided information for the nutrition content of lunch items and meals on data collection days. The software analyzes nutrition data for all items in a lunch (recipe for an entrée, any additional side items, and milk).

The amount of each food item remaining was estimated in 10% increments. Various estimation methods have been used in previous visual plate waste studies including a 6-increment scale (all remaining, almost all remaining, ¾ remaining, ½ remaining, ¼ remaining, none remaining) (Comstock et al., 1981; S. Dubois, 1990; Friedman & Hurd-Crixell, 1999), and 10%-increment scale (all, 90%, 80%, 70% etc. remaining) (Swanson, 2008; Williamson et al., 2003). A 10% increment scale was used in this research because that method was successfully used in two recent plate waste studies employing digital photography (Swanson, 2008; Williamson et al., 2003). These estimates were used to determine the nutrient intake of each student. Specifically, if a student left 20% of a chicken breast on her plate (consuming 80%), and the chicken breast has 300 calories, 6 grams of fat, and 20 grams of protein, data for that student will reflect consumption of 240 calories (300*.80), 4.8 grams of fat (6*.80), and 16 grams of protein (20*.80). This method of nutrient estimation was repeated for total energy and 13 total macro and micronutrients, similar to data collected in previous plate waste research (Templeton, Marlette, & Panemangalore, 2005). Totals for each macronutrient and micronutrient were summed from all food on a student's tray. Nutrient totals were recorded for both amounts taken (using information from the tray card) and amounts consumed (deduced from visual analysis of waste in digital photographs). Salad bar items were self-selected in each school; therefore there was no way to quantify a "before eating" serving size. Instead, the presence of specific salad bar items was recorded on the tray cards. The variable “Total FV” is a sum total of the number of unique fruits and vegetables selected from both the hot lunch line and the salad bar.

The type of milk selected by students was recorded on each tray card (skim white, 1% white, and 1% chocolate). Two dichotomous variables were created for milk choice: (1) whether students chose white milk or whether they chose chocolate milk/No milk, and (2) whether students who chose milk chose white milk over chocolate milk.

Plate waste photographs were analyzed by two different research assistants and compared for inter-rater reliability. Similar to previous digital plate waste research, the two rater’s estimated plate waste percentages were averaged for data analysis. If the discrepancy between the two raters was greater than 50%, the principal investigator assessed the photograph for a third rating, and the closest two of the three ratings was used to determine average plate waste (Swanson, 2008). Interrater reliability was measured for each individual category of collected data (grade, gender, and individual food/salad bar items): 34 categories of data on Day 1, 32 on Day 2, and 44 on Day 3. Kappa coefficients for all 110 rated categories are presented in Appendix F. Kappas less than 0.20 are poor in strength of agreement, Kappas of 0.21-0.40 are fair, Kappas of 0.41-0.60 are moderate, Kappas of 0.61-0.80 are good, and Kappas of 0.81-1.0 are considered very good in strength of agreement (Cohen, 1960). The number of Kappa coefficients in each of these categories for raw data and for data reconciled by a third researcher are summarized in Table 8.

Table 8: Interrater Reliability Kappa Coefficients

	Number of Variables with this Kappa	
Kappa Statistic	Raw Data	Reconciled Data
< 0.20	2	2
0.21 - 0.40	10	6
0.41 - 0.60	26	16
0.61 - 0.80	6	2
0.81 - 1.00	66	84
Note: total number of variables rated by two raters and reconciled by a third rater=110		

Statistical Analyses were performed with Stata 11 on amounts taken and amounts consumed for both GSW schools and non-GSW schools. Nutrient data for each food/menu for each of the three data collection days are presented in Tables 9-12.

Table 9: Menus for Data Collection Days

April 18-Weds	April 19 –Thurs	April 20-Fri	April 24-Tues (Weather Back Up)
Beef Stew - new Biscuits Green apples Salad bar Milk	**BBQ Chicken -new** WH grain dinner roll Light Peaches Baked beans Salad bar Milk	**Big Daddy Cheese Pizza with whole grain crust-new** Can Green Beans Red grapes Salad bar Milk	**Calzone-new** Broccoli Red Grapes Salad bar Milk

Table 10: Data for Menu Served on April 18

Nutrients	Units	Beef Stew/ 100g	Beef Stew/ 1 cup serving	Angel Biscuits /100g	Angel Biscuits/ 1oz biscuit	Apple Fresh/ 100g	Apple Fresh/ 1/2 cup	1% White Milk/ 100g	1% Wh Milk/ 8oz or 227g	Entire School Lunch	Units
Adjusted weight	gm	100	340.04	100	33.79	100	138	100	226	737.83	gm
Energy	kcals	105.98	360.37	270.38	91.36	52	71.76	44.09	100	623.49	kcals
Protein	g	6.21	21.11	6.56	2.22	0.26	0.36	3.53	8	31.69	g
Vitamin A (RE)	RE	132.19	449.49	0	0	5.0	6.9	44.09	100	556.39	RE
Vitamin A (IU)	IU	659.62	2242.96	0	0	54.0	74.52	220.5	500	2817.48	IU
Vitamin C	mg	2.72	9.25	0	0	4.6	6.35	1.06	2.4	18	mg
Iron	mg	1.24	4.23	1.1	0.373	0.12	0.17	0	0	4.773	mg
Calcium	mg	28.35	96.39	10.24	3.46	6.0	8.28	132.28	300	408.13	mg
Total Fat	g	2.45	8.33	7.16	2.41	0.17	0.23	1.1	2.5	13.47	g
Saturated Fat	g	0.72	2.45	1.93	0.65	0.03	0.04	0.66	1.5	4.64	g
Trans Fat	g	0.00	0	2.0	0.68	0.00	0	0	0	0.68	g
Carbohydrate	g	14.52	49.38	44.96	15.19	13.81	19.06	5.29	12	95.63	g
Total Fiber	g	1.82	6.17	0.78	0.27	2.4	3.31	0	0	9.75	g
Cholesterol	mg	8.94	30.38	0.90	0.03	0.00	0	4.41	10	40.41	mg
Sodium	mg	197.32	670.95	393.22	132.87	1.0	1.38	55.12	125	930.2	mg

Table 11: Data for Menu Served on April 19

Nutrients	Units	BBQ Chicken/ 100g	BBQ Chicken/ 1 piece	Whole Grain Dinner Roll/ 100g	Whole Grain Dinner Roll/ 1 oz roll	Light Peach/ 100g	Light Peach/ ½ cup	Baked Beans/ 100g	Baked Beans/ 1 cup	1% White Milk/ 100g	1% White Milk/ 8oz carton or 227g	Entire School Lunch	Units
Adjusted weight	gm	100	192.85	100	42.47	100	120.20	100	257.06	100	226	838.58	gm
Energy	kcals	214.18	413.04	249.72	106.06	55.56	66.78	107.69	276.83	44.09	100	962.71	kcals
Protein	g	15.86	30.58	6.3	2.68	0.00	0	4.62	11.86	3.53	8	53.12	g
Vitamin A (RE)	RE	9.30	17.94	0.0	0	47.62	57.24	0.00	0	44.09	100	175.18	RE
Vitamin A (IU)	IU	46.51	89.69	0.0	0	238.10	286.19	0.00	0	220.5	500	875.88	IU
Vitamin C	mg	0.74	1.41	0.01	0.00	0.95	1.14	0.00	0	1.06	2.4	4.95	mg
Iron	mg	0.34	0.66	1.84	0.78	0.00	0	1.39	3.56	0	0	5	mg
Calcium	mg	1.51	2.92	10.28	4.37	0	0	30.77	79.09	132.28	300	386.38	mg
Total Fat	g	15.82	30.50	5.03	2.14	0	0	0.77	1.98	1.1	2.5	37.12	g
Sat. Fat	g	4.99	9.62	0.98	0.41	0	0	0.00	0	0.66	1.5	11.53	g
Trans Fat	g	0.00	0	0.00	0	0	0	0.00	0	0	0	0	g
Carbo-hydrate	g	1.60	3.08	44.85	19.05	13.49	16.22	22.31	57.34	5.29	12	107.69	g
Total Fiber	g	0.07	0.14	0.51	0.22	0	0	3.85	9.89	0	0	10.25	g
Cholesterol	mg	53.93	104.00	0.05	0.02	0	0	423.08	0	4.41	10	114.02	mg
Sodium	mg	142.82	275.42	432.48	183.69	7.94	9.54	0.00	1087.6	55.12	125	1681.25	mg

Table 12: Data for Menu Served on April 20

Nutrients	Units	Big Daddy Cheese Pizza/ 100g	Big Daddy Cheese Pizza/1 slice	Canned Green Beans/ 100g	Canned Green Beans/ ½ cup	Red Grapes/ 100g	Red Grapes/ ½ cup	1% Wh Milk/ 100g	1% White Milk/ 8oz carton or 227g	Entire school lunch	Units
Adjusted weight	gm	100	135	100.00	128.85	100.00	90.72	100	226	580.57	gm
Energy	kcals	237.04	320	16.67	21.48	67.00	60.78	44.09	100	502.26	kcals
Protein	g	14.07	19	0.83	1.06	0.63	0.57	3.53	8	28.63	g
Vitamin A (RE)	RE	55.90		41.67	53.69	10.00	9.07	44.09	100	162.76	RE
Vitamin A (IU)	IU	279.51		208.33	268.43	100.00	90.72	220.5	500	859.15	IU
Vitamin C	mg	0.00		0.83	1.08	4.00	3.63	1.06	2.4	7.11	mg
Iron	mg	1.79		0.79	1.01	0.29	0.26	0	0	1.27	mg
Calcium	mg	223.61		36.66	47.24	14.00	12.70	132.28	300	359.94	mg
Total Fat	g	6.67	9	0.00	0	0.35	0.32	1.1	2.5	11.82	g
Saturated Fat	g	2.59	3.5	0.00	0	0.11	0.10	0.66	1.5	5.1	g
Trans Fat	g	0.00		0.00	0	0.00	0	0	0	0	g
Carbohydrate	g	28.89	39	3.31	4.26	17.15	15.56	5.29	12	70.82	g
Total Fiber	g	2.96	4	1.65	2.13	0.90	0.82	0	0	6.95	g
Cholesterol	mg	11.11	15	0.00	0	0.00	0	4.41	10	25	mg
Sodium	mg	362.96	490	322.31	415.30	2.00	1.81	55.12	125	1032.11	mg

Although 13 different nutrients are reported for every food served in the Aurora Public School Cafeterias, not all 13 nutrients would be expected to vary greatly based on GSW program participation. As a whole, students have few choices in the hot lunch line and most of their choices are Go and Slow foods resulting from Aurora's adoption of new scratch cooking changes across the entire district. Students do, however, have the ability to choose as many fruits and vegetables from the salad bar as they as they want. Given that the GSW curriculum (incentive days, menu review, activities in class) focuses on choosing “Go” foods with less processing, more whole grain, more whole foods (i.e. more fruits and vegetables), and less added sugar, it is most realistic that students in GSW schools would choose more fruits and vegetables, would choose milk (and white milk instead of chocolate milk), and would consume less fat/saturated fat and more fiber from eating more Go foods on their tray. For example, Chocolate Cake was served on Day 2 of this study. GSW administrators would hypothesize that fewer students from GSW schools would take cake (and therefore less total fat), and would take more fruits and vegetables, thus increasing their intake of fiber. If they chose not to take or to take but not eat all of the cake (average piece of cake across all schools=155 calories), those students might have “room” for more white milk (average of 90 calories per carton for 1% or skim white milk) or more fruits and vegetables (varied caloric content). They might have also chosen to take or drink more white milk regardless of cake consumption, simply because white milk is recommended as a GO food and because an incentive day is held each year where students earn a prize for drinking white milk. Therefore, descriptive statistics were included for all total nutrient, milk, and fruit/vegetable variables, but statistical models were run on only the following most relevant dependent variables that GSW is expected to influence:

- Did students choose white milk (skim and 1%) over chocolate milk or no milk?
- For students choosing milk, did they choose white milk (skim and 1%) over chocolate milk?
- Percentage of white milk consumed.
- Total number of fruits/vegetables taken.

- Total fiber taken.
- Total fiber consumed.
- Total fat taken.
- Total fat consumed.
- Total saturated fat taken.
- Total saturated fat consumed.

There is an important distinction between milk, fiber, fat, and saturated fat *taken* and *consumed*. Students' food choices in the lunch line may be influenced by GSW curriculum but other factors may come into play once they begin to eat that might make their actual food consumption lower on these key variables (white milk, high fiber, FV, lower fat options). These factors, detailed in the literature review, include: length of the lunch period, recess before lunch, peer role modeling, taste, smell, and teacher/staff role modeling.

The two dependent variables for choosing white milk are dichotomous dependent variables, whereas the remaining eight dependent variables are linear variables. Separate statistical models were calculated for each of the 10 dependent variables listed above. Because of the hierarchical nature of collecting data from students nested in schools, multilevel modeling was appropriate for our analyses. Student responses to an intervention are likely to be more correlated for students in the same school than for students in different schools, thus violating the assumption of independent responses and necessitating a statistical test other than traditional ANOVA and ordinary least-squares regression. A 2-level multilevel regression model can generate more accurate standard errors for program effect estimates and other important parameters in clustered designs than other statistical techniques like linear regression that do not account for data clustering. (Rabe-Hesketh & Skrondal, 2008; Raudenbush & Bryk, 2002) Multilevel models have more error terms and therefore more flexibility in defining the covariance structure. This flexibility leads to two distinct advantages: (1) more flexibility in the questions researchers ask about the covariance structure and because of the complexity of covariance structures able to be modeled, (2) better estimates of standard errors of the regression coefficients and resulting accuracy of confidence intervals (Berkhof & Kampen, 2004; Dedrick et al., 2009). Multilevel models also ensure more accurate effect sizes for an intervention and help avoid Type 1 errors and biased parameter estimates (Peugh, 2010; Wampold & Serlin, 2000). However, not all nested datasets require multilevel modeling. Multilevel modeling is necessary only if response variables vary across level-2 units (e.g. schools) (Peugh, 2010). In this study, response variable data was likely to differ across schools (mostly due to school characteristics such as demographics, achievement scores, and characteristics of PE teachers and other school personnel), therefore multilevel modeling was selected for analyses. Variance in the level-2 data was assessed by measuring intraclass correlation (ICC).

In this study, the ICC is both the proportion of nutrient/food values variation that occurs across schools (level-2 units) and the expected correlation between the nutrient/food values of two students (level-1 units) from the same school (Peugh, 2010). The ICC is similar to the R^2 effect size from regression and represents the proportion of student nutrient score variance that can be explained by mean nutrient score differences across schools. The ICC provides help in determining the necessity of multilevel modeling. An ICC value of zero indicates: (a) no mean nutrient score variation across schools (level-2), (b) all nutrient score variation occurs across students (i.e. level-1), and (c) traditional analysis techniques such as ANOVA and regression can be used to analyze the student data (Peugh, 2010). As the ICC value increases, the proportion of dependent variable score variation that occurs across schools increases, resulting in violations of the independence assumption and requiring multilevel modeling to analyze data.

Given that the ICC>0 in all models used in this study, a multilevel model that separates "variation between students" and "variation between schools" was utilized to determine if mean nutrient values differed significantly across schools. The most basic multilevel model to explain the potential differences in nutrient/food scores is shown with the following equations (Hox, 2010; Raudenbush & Bryk, 2002):

Equation 1: Level 1 : $\mathbf{Y_{ij} = \beta_{0j} + r_{ij}}$

Equation 2: Level 2 : $\mathbf{\beta_{0j} = \gamma_{00} + u_{0j}}$

Equation 1 shows that the differences in nutrient score of student *i* in school *j* (Y_{ij}) can be modeled as a function of the mean nutrient score for school j (β_{0j}) plus a residual term that reflects individual student differences around the mean nutrient score of school *j* (r_{ij}). Equation 2 shows that the mean nutrient score for school *j* (β_{0j}) can be modeled as a function of the grand-mean nutrient score (γ_{00}) plus a school-specific deviation from the grand mean (u_{0j}). Substituting Equation 2 into Equation 1 yields the combined unconditional multilevel modeling equation:

Combined multilevel modeling equation: $\mathbf{Y_{ij} = \gamma_{00} + u_{0j} + r_{ij}}$

This equation combines nutrient score variability into within-group (i.e., level-1, r_{ij}) and between-group (i.e., level-2, u_{0j}) components.

After estimating a multilevel model, the ICC is calculated with the following:

$$\mathbf{ICC} = \boldsymbol{\tau_{00}/(\tau_{00} + \sigma^2)}$$

where τ_{00} is the variance in nutrient score means across schools and σ^2 is the nutrient score variation across students within a school. An ICC predicts the proportion of variance that occurs across schools, and typically an ICC value between .05 and .20 is common in cross-sectional multilevel modeling applications in social research studies (Peugh, 2010). In this research, ICC values ranged from 0.04-0.47.

It should be noted that a random effects multilevel linear regression was not appropriate for one outcome variable. The percent of white milk consumed represented a proportion variable bound on the upper and lower ends by zero and one. This outcome variable was analyzed with a generalized linear model with logit link and a binomial outcome ranging from zero to one and clustering on school ID. Although it did not estimate the intraclass correlation, this model allowed for correct estimation of standard errors and analysis of the overall effect of the intervention and student-level covariates.

To determine the extent to which GSW is associated with the outcome independent of individual student characteristics, this study used multilevel modeling to partition the variance between schools and student level characteristics for nine outcome variables. Models were run with restricted maximum likelihood (REML) estimation because of the ability of REML to attain more accurate variance estimates in smaller sample sizes (Peugh, 2010; Raudenbush & Bryk, 2002). REML treats regression coefficients as unknown quantities and estimates coefficients and variance estimates from sample data, subtracting the appropriate amount of degrees of freedom. Conversely, maximum likelihood estimation treats regression coefficients as known population parameters and does not allocate any degrees of freedom to the estimation (Peugh, 2010). The resulting variance estimates from maximum likelihood estimation are underestimated, especially when the sample size is small. Brown and Draper (2000) show that restricted maximum likelihood estimation provides reasonable variance estimates with as few as 6-12 groups (Browne & Draper, 2000).

Because the effect of individual schools on overall results was unknown, schools were treated as a random effect in our model. Student level characteristics (grade and gender) were added as fixed effects to examine their independent contributions to food and nutrient consumption. Treatment condition was added as both a random effect to some models and a fixed effect to others and models were compared to determine the best fitting model. Analyzing treatment condition (GSW or non-GSW) as a random effect utilized a random-coefficient model where the effect of GSW was allowed to vary across schools, producing a different coefficient for each school. Analyzing treatment condition as a fixed effect utilized a random-intercept model where the effect of GSW was reported as an intercept, or a mean effect for all schools. Testing whether the random-coefficient model fit better than the nested random-intercept model was accomplished in Stata 11 with a likelihood-ratio test of the two models (Rabe-Hesketh & Skrondal, 2008). Of the nine dependent variables, none of the likelihood-ratio tests were significant, indicating that the random-intercept model should not be rejected in favor of the random-coefficient model. Therefore, treatment condition was treated as a fixed effect in all models.

Model selections were confirmed by examining Akaike's Information Criterion (AIC) and Schwartz's Bayesian Information Criterion (BIC) for each model (Akaike, 1974); Schwarz, 1978).

$AIC = -2LL+2p$

- where LL is the log likelihood and p is the number of ML-estimated parameters.

$BIC=-2LL+p\ ln(N)$

- where N is the sample size at Level 1.

Both the AIC and BIC start with the log-likelihood value and subsequently penalize for the number of covariance parameters estimated. The BIC creates a bigger penalty for the number of parameters estimated (Dedrick et al., 2009). AIC and BIC for all 10 random coefficient models and all 10 random intercept models are shown in Appendix G.

Results from likelihood ratio tests and AIC/BIC comparisons favor the random-intercept models over random coefficient models, treating schools as a random effect and treatment condition, grade, gender, and day of the study/entree as fixed effects. The final models in this study contain both fixed and random effects and are considered mixed-effects models.

Other post-estimation commands were used in this study to show the superiority of multilevel modeling over standard regression techniques in the final models. Using Stata 11, likelihood-ratio (LR) tests for all ten final multilevel models compared multilevel modeling (Linear and Logistic Mixed Effects Models) to standard linear and logistic regression. The LR test is testing whether an estimated variance component is different from zero, and whether or not multilevel modeling is a better fitting model than standard linear or logistic regression. All ten likelihood-ratio tests were significant at p=.001, indicating that multilevel modeling was superior to standard linear and logistic regression for all models in this study. ICC and likelihood ratio tests were utilized to determine that multilevel modeling was the most appropriate modeling technique for collected data.

Several assumptions should be met for multilevel modeling. The normality assumption was assessed in all models by examining the distribution of Level 1 residuals. Deviance residuals were calculated for Level 1 residuals in the two white milk logit models as recommended by previous studies (McCullagh & Nelder, 1989). Deviance residuals have the best properties for examining goodness of fit. Residual graphs for all multilevel models are found in Appendix H.

Data were screened for outliers to identify data-entry errors, inaccurate coding of a student, missing values coded incorrectly, or simply individuals who are different from others students in the sample.

Formulae for Multi-Level Model.

*Note: Outcome variable is listed as “Total Fat Grams Taken” in the equations below. Separate multilevel models were created for all outcome variables (9 in total).

Model 1: Y (Total Fat Grams TAKEN) = α (intercept) + b_1X_1 (GSW participation-Level2 Main Effect) + b_2X_2 (Gender-Level 1) + b_3X_3 (Grade-Level 1) + b_4X_4 (Day of Data Coll.-Level 1) +ε

Model 2: Y (Total Fat Grams CONSUMED) = α (intercept) + b_1X_1 (GSW participation-Level 2 Main Effect) + b_2X_2 (Gender-Level 1) + b_3X_3 (Grade-Level 1) b_4X_4 (Day of Data Coll.-Level 1) +ε

Table 13: Multi-level Model for Control and Main Effect Predictor Variables

Predictor Variables (Main Effects)
GSW Participation
Level 1-Control Variables
Gender
Grade Level
Day 1, 2, or 3
Level 2-Control Variables
None – school sample size too small

Adding in additional predictor variables at the school level (i.e. mean school SES, ELL, etc.) was not possible due to the very small number of schools (10) included in this study.

Qualitative Data Analysis: Aim 2

Using a combination of deductive and inductive methods, salient themes were identified related to teacher opinions regarding Scratch Cooking Cafeteria Changes and GSW implementation and effectiveness. Teacher interviews were analyzed using codes emerging from literature/hypotheses and in vivo codes emerging from collected data, and subsequently determining themes within and across schools.

A qualitative analysis was used with a five stage iterative process to analyze the transcripts: (1) development of a coding schedule; (2) coding of the data; (3) description of the main categories; (4) linking of categories into major themes; and (5) the development of explanations for the relationships between themes (Hsieh & Shannon, 2005; Pope, Ziebland, & Mays, 2000). An ecological framework for program implementation was utilized as a lens through which to analyze the implementation and impact of GSW (Durlak & DuPre, 2008). Interview transcripts were analyzed within the context of three main categories of this ecological framework: innovations/program characteristics, individuals and communities, and features associated with program delivery and program support.

For all interviews, codes were generated and recorded in a table. This table also includes excerpts from teacher comments relating to each code. The resulting codes and comments were grouped, as appropriate, into overall themes and findings from qualitative data collection. These qualitative data and analyses assisted in several ways including: (1) helping to make sense of quantitative data; and (2) documenting dose, implementation fidelity, likability, and impact of the GSW program in APS.

GSW implementation (dose, quality, adherence/fidelity) was also assessed using informal conversations with cafeteria staff and school personnel and observations by researchers while in schools. The implementation of GSW programming was assessed by coding transcribed interviews, organizing them into themes, and drawing conclusions from these themes. Implementation of Scratch Cooking Cafeteria Changes was also assessed using observations by researchers during data collection days. The implementation of Scratch Cooking Cafeteria Changes should be similar across schools, as all schools follow the same district-wide menus and food ordering is done in a central location for all schools. However, given the variability that could occur due to shipping of food, leftover food, and cafeteria worker "buy-in" to Scratch Cooking Cafeteria Changes, there could be variability in implementation. Data from collected field notes assessed menu similarity across schools.

Qualitative data helped to inform the interpretation of quantitative analyses. Linking qualitative data to quantitative data has several benefits: (a) to enable confirmation or corroboration via comparison; (b) to elaborate or develop analysis, providing richer detail; and (c) to initiate new lines of thinking through attention to surprises or paradoxes (Rossman & Wilson, 1994). Analyzing qualitative interviews and observations and quantitative plate waste data together provided far greater information than either method of data collection alone.

Human Subjects Review

Because this study used original data collected with children in Aurora Public schools, proper safeguards were taken to ensure the safety of all study participants. Approval from the Colorado Multiple Institutional Review Board (COMIRB), LiveWell Colorado, and Aurora Public Schools was obtained before data collection began. Students were asked for verbal informed consent in the lunch line. Student names were not collected, and faces were not photographed.

CHAPTER IV

QUANTITATIVE RESULTS

Descriptive Statistics

Of 2,223 collected and photographed lunch trays, 1123 (51%) came from GSW schools and 1100 (49%) came from non-GSW comparison schools. The sample was split fairly evenly among 1st graders, 3rd graders, and 5th graders and among male and female students. Among the entire sample of all schools over three days, the average number of calories taken in the hot lunch line was 553 (s.d. 134), whereas the average number of calories consumed by the end of lunch was 292 (s.d. 154). The characteristics of lunch trays collected from intervention and comparison groups are shown in Table 14.

Table 14: Characteristics of GSW and Non-GSW Schools

	GSW Schools	Comparison Schools
Level: Student		
Students, n	1123	1100
Gender - no./total no. (%)		
Male	512/1038 (49)	526/1038 (51)
Female	528/1048 (50)	520/1048 (50)
Missing Data	77/137 (56)	60/137 (44)
Grade - no./total no. (%)		
Grade 1	374/755 (50)	381/755(50)
Grade 3	356/734 (49)	378/734 (51)
Grade 5	369/728 (51)	359/728 (49)
Missing Data	1/6 (17)	5/6 (83)
Tray Contents -		
Took White Milk - no./total no. (%)	254/386 (66)*	132/386 (34)*
% White Milk Consumed - mean (s.d.)	.55 (0.43)	.53 (0.40)
Total FV Taken - mean (s.d.)	1.17 (0.86)*	1.44 (0.84)*
Total Fiber Taken - mean (s.d.)**	5.12 (2.66)*	5.85 (2.87)*
Total Fiber Consumed - mean (s.d.)**	2.00 (1.35)*	2.23 (1.62)*
Total Fat Taken - mean (s.d.)	19.82 (11.34)*	17.89 (9.04)*
Total Fat Consumed - mean (s.d.)	10.83 (7.52)*	10.04 (7.12)*
Total Saturated Fat Taken - mean (s.d.)	7.07 (3.01)*	6.27 (2.73)*
Total Saturated Fat Consumed - mean (s.d.)	4.02 (2.64)*	3.62 (2.65)*
Total Calories Taken - mean (s.d.)	540 (121.00)*	566 (143.65)*
Total Calories Consumed - mean (s.d.)	294.79 (145.23)	290.13 (161.58)
Level: School		
Schools, n	5	5
Race/Ethnicity		
White - % of students in school	18.3	19.16
Black - % of students in school	17.62	17.86
Asian - % of students in school	3.18	3.52
Hispanic - % of students in school	56.74	54.74
Native American - % of students in school	0.96	0.88
Native Hawaiian - % of students in school	0.14	0.3
Two or more Race/Ethn - % of students in school	3.04	3.54
Free/Reduced Lunch - % of students in school	75.74	72.72
Gifted and Talented - % of students in school	2.02	2.28
Special Education - % of students in school	8.86	9.04
English Language Learners - % of students in school	48.34	45.56
Number of Nutrition Programs - no. in school	0.8	0.8

* Significant mean differences between tray contents of GSW Schools and Comparison Schools (p<.05)
** Total Fiber Taken and Consumed does NOT take into account salad bar items.

While the averages of all dependent variables are organized by intervention and comparison groups and reported in Table 14, individual averages for each school are important when assessing program implementation and program outcomes. Individual averages are also important for school administrators, teachers, and parents at each school. The GSW program is expected to influence the choosing and consumption of white milk, total fruits and vegetables, fiber, total fat, and saturated fat. These particular characteristics of lunch trays collected from each school are shown in Table 15. Graphs of these tray contents at each school are shown in Figures 11-19.

Table 15: Average Characteristics of Tray Contents by School

Tray Contents	Altura	Arkansas	Crawford	Dartmouth	Fletcher	Jewell	Lansing	Vassar	Vista Peak	Wheeling	All Schools
% students who took White Milk over No Milk/Choc Milk-% *	20	12	12	18	13	9	10	27	46	6	17.30
% White Milk Consumed-% *	51.00	63.00	36.00	56.00	67.00	36.00	78.00	68.00	49.00	14.00	51.80
Total FV Taken-no.*	1.15	1.92	1.21	1.52	1.28	1.12	0.91	1.26	1.35	1.35	1.31
Total Fiber Taken-no. grams*	6.75	7.21	4.80	7.73	5.11	4.10	4.91	4.05	5.03	5.13	5.48
Total Fiber Consumed- no. grams*	1.80	2.73	2.13	2.94	2.22	1.47	2.07	1.70	2.27	1.82	2.12
Total Fat Taken -no. grams*	24.88	19.03	19.39	18.40	18.60	13.98	17.83	18.05	18.92	19.31	18.84
Total Fat Consumed-no. grams*	10.49	10.37	11.58	10.76	11.46	8.78	11.25	9.18	11.48	8.79	10.41
Total Sat Fat Taken-no. grams*	8.48	6.46	6.87	6.40	6.79	4.98	6.32	7.01	6.74	6.68	6.67
Total Sat Fat Consumed-no. grams*	3.78	3.53	4.10	3.87	4.37	3.04	4.19	3.84	4.16	3.29	3.82

* F-test significant (p<.05)

Total Fiber Taken and Consumed does not take into account salad bar items.

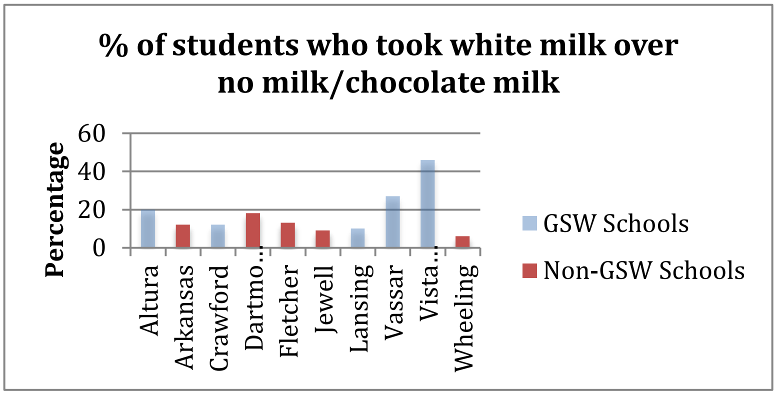


Figure 11: Students Taking White Milk

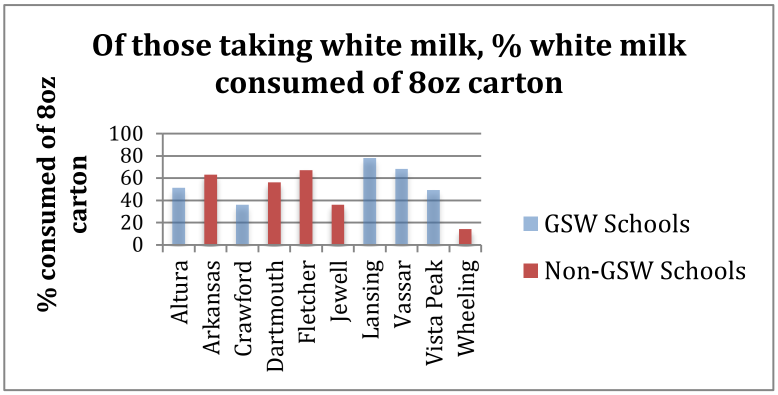


Figure 12: White Milk Consumed

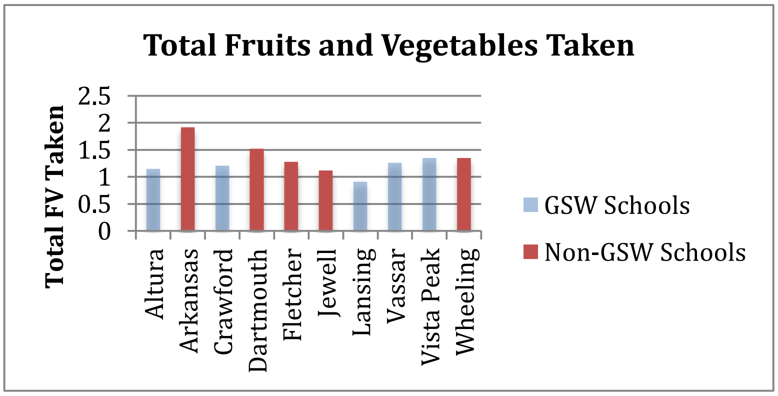


Figure 13: Total Fruits and Vegetables Taken

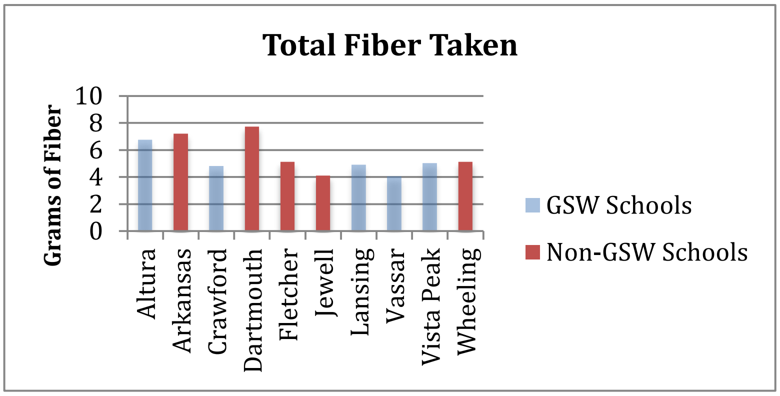


Figure 14: Total Fiber Taken

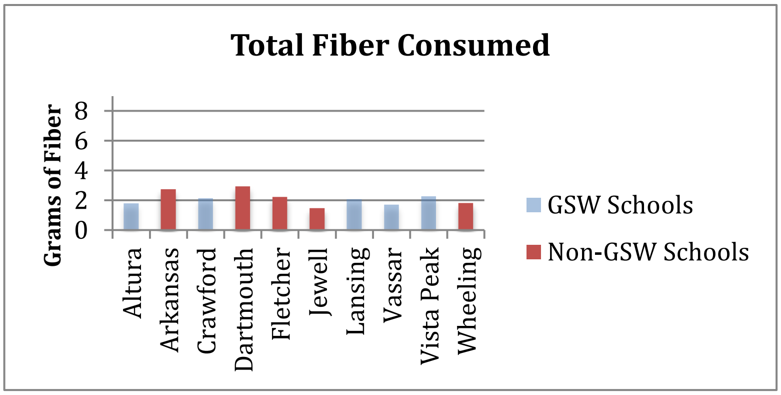


Figure 15: Total Fiber Consumed

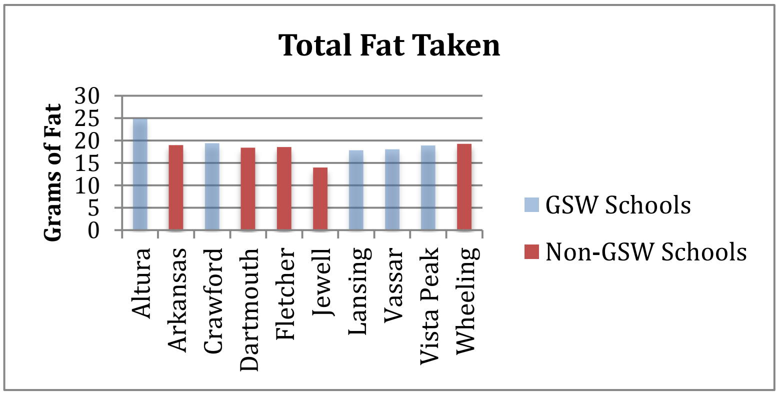


Figure 16: Total Fat Taken

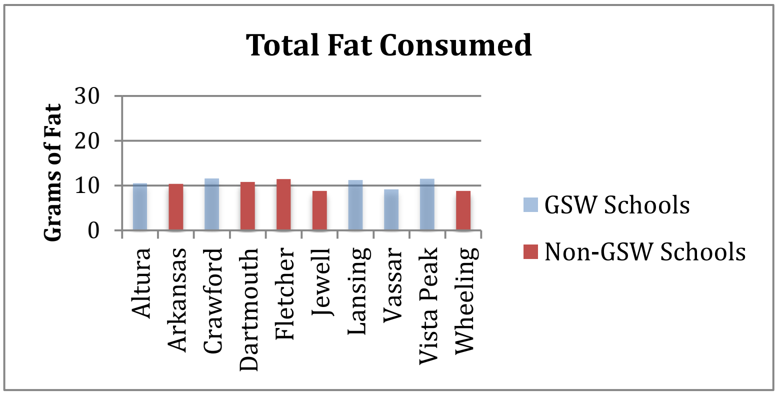


Figure 17: Total Fat Consumed

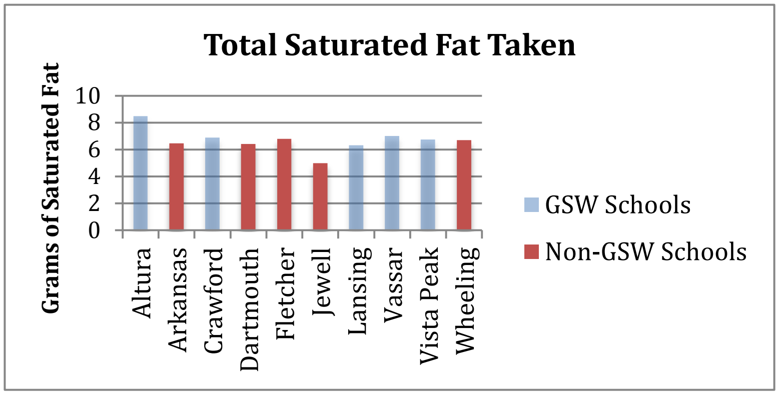


Figure 18: Total Saturated Fat Taken

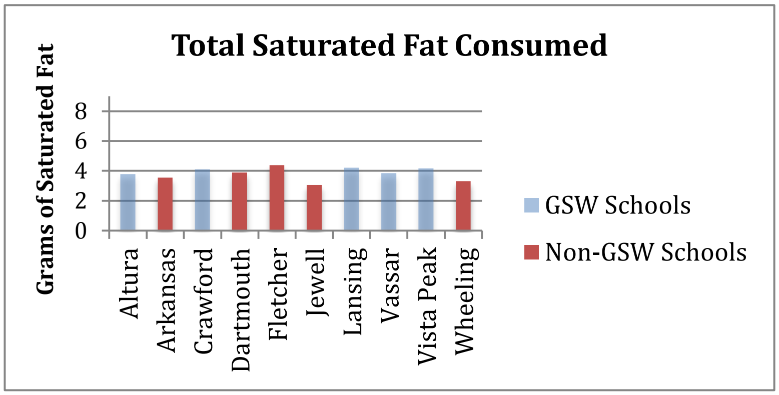


Figure 19: Total Saturated Fat Consumed

The overall numbers of male trays and female trays included in this study are similar, with 1048 females (47.1%), 1038 males (46.7%) and 137 missing (6.2%) due to research assistant oversight. However, the breakdown of males and females by school, day of data collection, and grade did not result in such even gender numbers of tray cards. Although researchers aimed to collect 14 trays from female students and 14 trays from male students per grade per day, the dynamics of school cafeterias and clusters of same-gender students in line prevented such precision. When looking at the sample size at the lowest level (number of students per grade on one day at one school), the cell sizes for gender (which ideally would be 14 for each gender) range from 2 to 20. Of 180 sample size cells (10 schools x 3 days of data collection x 3 grades x 2 genders), 41 (23%) cells had sample sizes less than 10. The other 139 (77%) had sample sizes between 10 and 20. Fourteen of the 180 cells (8%) had fewer than 8 students. Overall, only 6 out of 2223 tray cards were missing grade level information. Table 16 shows the gender breakdown by school, day, and grade.

Table 16: Sample Sizes-Number of Trays Collected

School	Grade	Day 1 - No. Trays	Day 2 – No. Trays	Day 3 – No. Trays
		reported as: no. females[f], no. males[m], no. missing sex[*]		
Altura	1	**23** (10f,11m,1*)	**25** (16f,9m,0*)	**25** (10f,10m,5*)
	3	**25** (15f,6m,4*)	**26** (17f,3m,6*)	**25** (15f,7m,5*)
	5	**22** (11f,9m,2*)	**25** (15f,10m,0*)	**23** (10f,11m,2*)
Arkansas	1	**25** (13f,10m,2*)	**26** (11f,14m,1*)	**25** (15f,10m,0*)
	3	**23** (13f,9m,1*)	**26** (9f,16m,1*)	**22** (10f,11m,1*)
	5	**25** (10f,11m,4*)	**24** (8f,12m,4*)	**25** (11f,14m,0*)
Crawford	1	**26** (13f,13m,0*)	**25** (13f,11m,1*)	**26** (13f,10m,3*)
	3	**24** (14f,9m,1*)	**22** (14f,6m,2*)	**26** (12f,12f,2*)
	5	**18** (9f,9m,0*)	**26** (15f,11m,0*)	**28** (18f,9m,1*)
Dartmouth	1	**25** (9f,16m,0*)	**25** (8f,15m,2*)	**27** (10f,14m,3*)
	3	**23** (7f,14m,2*)	**2**1 (7f,14m,0*)	**26** (8f,14m,3*)
	5	**28** (11f,16m1*)	**26** (9f,17f,0*)	**21** (7f,11m,3*)
Fletcher	1	**25** (14f,8m,3*)	**26** (14f,10m,2*)	**26** (14f,9m,3*)
	3	**26** (12f,14m,0*)	**26** (14f,12m,0)	**27** (11f,15m,1*)
	5	**24** (13f,11m,0*)	**24** (13f,11m,0*)	**26** (12f,13m,1*)
Jewell	1	**27** (17f,9m,1*)	**25** (19f,2m,4*)	**24** (16f,8m,0*)
	3	**26** (16f,10m,0*)	**25** (11f,13f,1*)	**25** (13f,11m,1*)
	5	**17** (8f,9m,0*)	**23** (12f,11f,0*)	**23** (13f,10m,0*)
Lansing	1	**24** (11f,13m,0*)	**27** (12f,15m,0*)	**26** (11f,14m,1*)
	3	**26** (7f,18m,1*)	**27** (10f,17m,0*)	**26** (6m,19f,1*)
	5	**25** (7f,16m,2*)	**25** (10f,13m,2*)	**26** (10f,16m,0*)
Vassar	1	**23** (9f,6m,8*)	**26** (13f,11m,2*)	**24** (9f,15m,0*)
	3	**0** (field trip this day)	**26** (7f,16m,3*)	**25** (10f,13m,2*)
	5	**26** (11f,15m,0*)	**26** (12f,13m,1*)	**26** (13f,13m,0*)
Vista Peak	1	**25** (11f,13m,1*)	**23** (14f,9m,0*)	**26** (13f,13m,0*)
	3	**26** (15f,11m,0*)	**26** (14f,11m,1*)	**26** (13f,13,0*)
	5	**25** (13f,12m,0*)	**24** (13f,11m,0*)	**24** (14f,10m,0*)
Wheeling	1	**27** (8f,3m,16*)	**23** (9f,14m,0*)	**25** (11f,12m,2*)
	3	**31** (11f,20m,0*)	**25** (8f,14m,3*)	**26** (14f,7m,5*)
	5	**25** (15f,10m,0*)	**25** (12m,12f,1*)	**23** (12f,9m,2*)
Total:		**715** (333f,331m,51*)	**755** (360f,354m,41*)	**753** (355f,353m,45*)

Aim 1: Determine the relative impact of GSW and Scratch Cooking Cafeteria Changes over and above the impact of Scratch Cooking Cafeteria Changes alone on students' choices and consumption of school lunch

Hypothesis 1a: Students receiving the GSW program will *choose* more healthy foods at school than non-GSW students.

Hypothesis 1b: Students receiving the GSW program will *consume* more of the healthy foods on their school lunch tray than non-GSW students.

Hypothesis 1c: Students receiving the GSW program will *choose and consume* more overall fruits and vegetables, white milk, and fiber, and less fat and saturated fat than non-GSW students.

Results Related to Hypotheses

Effects of GSW on Healthy Food Choice and Consumption

Students enrolled in schools with the GSW program showed significantly increased odds of choosing white milk (OR=2.17, p=0.05) over chocolate milk or no milk when controlling for gender, grade, and day of data collection (with different food offerings each day). None of the other models produced significant differences between students in GSW schools and students in non-GSW schools when controlling for gender, grade, and day of data collection. However, although the differences are not significant, students in GSW schools drank more milk (Coeff=0.07, p=0.52), took fewer vegetables (Coeff=-0.26, p=0.10), took and consumed less grams of fiber (Coeff=-0.63, p=0.043; Coeff=-0.25, p=0.42), took and consumed more total grams of fat (Coeff=1.45, p=0.40; Coeff=0.35, p=0.66), and took and consumed more grams of saturated fat (Coeff=0.64, p=0.21; Coeff= 0.26, p=0.30) than students in non-GSW schools.

Additional Results

Effects of Grade

Significant effects of grade were found for choosing white milk, the amount of white milk consumed, total fruits and vegetables taken, total fiber consumed, total fat consumed and total saturated fat consumed. Students in grade five took more white milk than students in grade one (Coeff=0.69, p=0.02). Students in grade three and grade five drank more of their white milk than students in grade one (Coeff=0.56, p=0.00;

Coeff=0.78, p=0.00). Students in grade three and five took less fruits and vegetables than students in grade one (Coeff=-0.12, p=0.00; Coeff=-0.07, p=0.00). Students in grades 3 and 5 consumed more total fiber than students in grade one (Coeff=0.36, p=0.00; Coeff=0.45, p=0.00). Students in grades three and five consumed more total fat than students in grade one (Coeff=1.06, p=0.00; Coeff=0.78, p=0.00) and more saturated fat than students in grade one (Coeff=0.52, p=0.00; Coeff=0.41, p=0.00).

Effects of Gender

Significant effects of gender were found for choosing white milk, total fiber consumed, total saturated fat consumed, and total fat consumed. Boys took white milk less often than girls (OR=0.78, p=0.04), consumed less total fruits and vegetables (Coeff=-0.08, p=0.04) and consumed more total fiber than girls (Coeff=0.14, p=.002). Boys consumed more total fat and saturated fat than girls (Coeff=0.93, p=0.00; Coeff=0.43, p=0.00).

Effects of Meal/Day of Study

Significant effects were also found for day of the study (with three different menus for each of the three days). Students chose significantly more white milk on pizza day compared to beef stew day (OR=2.11, p=0.00), took significantly less fruits and vegetables on chicken day and pizza day compared to beef stew day (Coeff=-0.27, p=0.00; Coeff=-0.13, p=0.00), took significantly less fiber on chicken day and pizza day compared to beef stew day (Coeff=-2.47, p=0.00; Coeff=-5.21, p=0.00), and consumed less fiber on chicken day and pizza day compared to beef stew day (Coeff=-0.62, p=0.00; Coeff=-0.29, p=0.00). Students took more total fat on chicken day and pizza day compared to beef stew day (Coeff=21.38, p=0.00; Coeff 6.57, p=0.00), consumed more total fat on chicken day and pizza day compared to beef stew day (Coeff=10.72, p=0.00; Coeff=7.79, p=0.00), took more saturated fat on chicken day and pizza day compared to beef stew day (Coeff=5.59, p=0.00; Coeff=4.54, p=0.00) and consumed more saturated fat on chicken day and pizza day compared to beef stew day (Coeff=2.55, p=0.00; Coeff=4.25, p=0.00).

Table 17 shows the multivariable models for all outcome variables and the adjusted odds ratios, coefficients and 95% confidence intervals.

Table 17: Final Adjusted Multilevel Models

	Choosing White Milk over Choc Milk/No milk (n=2084) xtmelogit	Choosing White Milk over Choc Milk (n=1778) xtmelogit	Percent of White Milk Drunk - of 8oz (n=362) glm	Total FV Taken (n=2081) xtmixed	Total Fiber Taken (n=2084) xtmixed	Total Fiber Consumed (n=2084) xtmixed	Total Fat Taken (n=2084) xtmixed	Total Fat Consumed (n=2084) xtmixed	Total Saturated Fat Taken (n=2084) xtmixed	Total Saturated Fat Consumed (n=2084) xtmixed
Variance at School Level (ICC) (n=10)	9.60%	7.39%	n/a	7.99%	46.56%	10.18%	27.84%	4.33%	24.91%	3.65%
Variable	**Odds Ratio**	**Odds Ratio**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**
Intercept (for linear regression)			-0.51	1.67	8.43	2.22	8.95	2.89	3.03	0.86
			(-1.28,0.27)	(1.44,1.90)	(7.30,9.55)	(1.77,2.66)	(6.51,11.39)	(1.66,4.12)	(2.31,3.75)	(0.47,1.26)
School Level Variables										
Intervention										
Non-GSWSchool	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
GSW School	2.12	1.95	0.03	-0.26	-0.63	-0.25	1.45	0.35	0.64	0.26
	(1.00,4.72)*	(0.98,3.88)	(-0.62,0.67)	(-0.56,0.05)	(-2.21,0.94)	(-0.85,0.35)	(-1.94,4.85)	(-1.20,1.91)	(-0.36,1.64)	(-0.24,0.75)
Day										
Day 1	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Day 2	1.29	1.26	0.07	-0.27	-2.47	-0.62	21.38	10.72	5.59	2.55
	(0.94,1.76)	(0.92,1.73)	(-0.52,0.66)	(-0.36,-0.19)**	(-2.61,-2.32)**	(-0.77,-0.48)**	(20.92,21.85)**	(10.13,11.32)**	(5.44,5.74)**	(2.35,2.75)**
Day 3	2.11	2.14	0.16	-0.13	-5.21	-0.29	6.57	7.79	4.54	4.25
	(1.56,2.84)**	(1.58,2.89)**	(-0.79,1.12)	(-0.21,-0.04)**	(-5.36,-5.07)**	(-0.44, -0.15)**	(6.11,7.04)**	(7.19,8.38)**	(4.39,4.68)**	(4.05,4.46)**
Student Level Variables										
Gender										
Female	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Male	0.78	0.74	0.37	-0.08*	-0.00	0.14	-0.12	0.93	0	0.43
	(0.61,0.99)*	(0.58,0.95)*	(-0.07,0.80)	(-0.15,-0.00)	(-0.12,0.12)	(0.02,0.27)*	(-0.50,0.26)	(0.44,1.42)**	(-0.12,0.12)	(0.26,0.59)**
Grade										
Grade 1	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Grade 3	1.02	1.14	0.56	-0.12	-0.01	0.36	-0.17	1.06	-0.03	0.52
	(0.77,1.35)	(0.86,1.52)	(0.22, 0.90)**	(-0.20,-0.03)**	(-0.15,0.13)	(0.21, 0.51)**	(-0.64,0.29)	(0.47,1.66)**	(-0.17,0.12)	(0.31,0.72)**
Grade 5	0.69	0.88	0.78	-0.07	0.01	0.45	-0.39	0.78	-0.25	0.41
	(0.52,0.93)*	(0.65,1.19)	(0.26, 1.30)**	(-0.16,0.02)**	(-0.13,0.15)	(0.31,0.60)**	(-0.85,0.07)	(0.19,1.37)**	(-0.39,-0.10)**	(0.21,0.61)**
P value *<.05 **<0.01										

CHAPTER V

QUALITATIVE RESULTS

Aim 2: Determine the relative dose, quality and adherence/fidelity of GSW implementation in each GSW school and relate implementation to observed outcomes.

Hypothesis 2a: Students in schools with higher dose and better quality and adherence/fidelity of GSW programming will show more positive results of GSW programming (Hypotheses 1a, 1b, 1c).

Analyses of qualitative interviews revealed several important themes related to the GSW program and program implementation. These themes include program leadership, program details and information, personal motivation and enthusiasm for the GSW program, lack of time for GSW curriculum, administration support, influence of parents and family on food intake, and student responses to scratch cooking changes and GSW components. An ecological framework for program implementation will be utilized as a lens through which to analyze the implementation of GSW (Durlak & DuPre, 2008). Three main categories of this ecological framework include: innovations/program characteristics, individuals and communities, and features associated with program delivery and program support. Although qualitative interviews revealed important themes related to all three framework groups, the third category, features of the program delivery and support system, had the greatest impact on a cascade of negative GSW program implementation issues and program outcomes. Although the program itself along with the teachers, administrators, and families in each school have a role in program effectiveness, this analysis primarily focused on program delivery and the program support system.

Program Delivery and Support System

Overall Program Goals and Expectations

The most commonly reported theme was insufficient district leadership for the GSW program, and specifically *uncertainty* regarding the overall goals of the GSW program, the individual components included in ideal implementation, and the components of the GSW program falling under PE teacher responsibility. Insufficient leadership is defined as insufficient materials, communication, motivation, follow-up, technical assistance, and involvement for optimal program success. Outcomes related to this insufficient leadership include poor shared understanding of program goals and components resulting in varying dose and fidelity of program implementation.

Uncertainty related to GSW program goals and ideal implementation was reported by five of seven physical education teachers. The program is kicked off in the fall at any new schools beginning the GSW program with a school-wide assembly. This assembly is scripted with exact lines for PE teachers, 9 News spokespeople, and mascots (the Avalanche Mascot and GSW-specific Power Panther). Although teachers appreciate the clarity of assembly materials and ease of assembly implementation, most reported uncertainty as to expectations following the assembly. One teacher reported not doing one single thing related to GSW this school year between the date of the assembly (in September) and the date of the interview (in December). Other teachers reported a lack of understanding of the goals of the GSW program and of what, exactly, P.E. teachers are responsible for teaching and doing in their classrooms.

> We had it on our menu and we didn't really know what it was. I thought we were already doing the Go Slow Whoa program because it's on our menu. (Teacher F)

This particular teacher began the GSW program with an assembly this year, but continues to be confused by what is expected of the P.E. teacher and the other people involved with GSW at each school.

> I don't even get expectations. I just recently got an email about incentive day. Okay, so am I doing that? Or is my principal doing that? Is it just within the building? I'm just not sure.
>
> Am I supposed to be doing this? Because the same thing happened with the surveys, I didn't do the surveys. Emails were still written to me about the surveys, but I didn't run the surveys. (Teacher F)

One teacher who has been implementing GSW curriculum for three years had no idea that the school lunch menus were coded with GSW labels. Other teachers identified uncertainty in the program and program implementation.

> I didn't know how things were going or how it was set up or how it was being done.
> You're doing it by yourself. There's no model to go off of. (Teacher D)

Teachers have lots of important health information from various programs (Flat Fourteeners, GSW, 5th Gear Kids, pacing guide standards) and struggle with how to fit them all in with little guidance.

> I got puzzle a's part and puzzle b's part and I got my own. Now I gotta figure out how I can make all three programs run at the same time, yet no one is around to help or to show you. It would just be nice to kind of have a meeting. (Teacher D)

Another teacher reported:

> I mean, you guys gave basic ideas but even then you really still need to kind of perfect if for each grade level. That's a lot of work. If it was in a book and it was this is what you're doing with kindergarten, this is what you do in first grade, this is what you do with second grade, that works for me. _____, has been [teaching] for 17 years, but I've been doing it for

> only seven. She can do it. She's one of those people that can do it. Right now, for a lot of people that are still trying to come in and figure out how they are going to teach every day, to have something in a book, concrete would be helpful. (Teacher C)

Unfortunately, when confronted with unclear expectations, vague ideas for implementation, and other health information and programs, many of the teachers are ignoring GSW curriculum and not implementing anything in addition to kick-off assemblies and three incentive days per year. These two components are vastly different than the ideal implementation created by GSW administrators and LiveWell Colorado.

One of the administrators of the GSW program acknowledged that mandating specific curriculum would be helpful to teachers, but that Nutrition Services is not authorized to mandate such additions to P.E. teacher curriculum. When asked if she visits the teachers and shares expectations for implementing the GSW program, the administrator responded with:

> We can't do that. We went through the nutrition and health standards and found resources that would align with those standards that they could use in PE. But, we don't have anything to say or do with who is doing what. (GSW administrator)

Therefore, the GSW administrators can only recommend resources and activities. Because of this, whether or not GSW activities and curriculum are implemented in each school depends less on program expectations and more on teacher enthusiasm, motivation and available time.

Waning Enthusiasm

Five of seven teachers mentioned that the excitement and enthusiasm of the kick-off assembly at their schools was followed by diminished interest, support, and sustainability by GSW, district, and school administrators. Unfortunately, this waning "push" for the GSW program makes some teachers feel like the school district is just trying to check boxes for the GSW roll-out without paying particular attention to the long term sustainability and success of the program.

> Sometimes I feel like we are doing things just to say we're doing them at the district level. But, what is really going on? And, are you really supporting it? That's really frustrating to me. (Teacher A)

Another teacher added:

> You know, I hate to say it but right now it feels like they just wanted us to get it kicked off just to get it kicked off. You know what I mean? Just to put a date on it and say, 'Okay five schools do it this year and we're going to have these schools do it next year.' (Teacher D)

After the kick-off assembly, the enthusiasm diminished and contact with the district GSW coordinator declined. And then attention to GSW popped up again when it was time to complete an incentive day, but to many teachers it felt like just one more check box for data collection instead of a solid and sustainable program component. Students should be encouraged to "try" more fruits and vegetables and other healthy foods on more than just three days per year. By encouraging food tasting with only three incentive days, teachers interpret those days as yet another way that the GSW program is only skimming the surface with minimal impact.

> I just don't know. If we want them to just do it on one day, is that going to form a habit? (Teacher F)

Another teacher responded with:

> The incentive days, they [GSW district administrators] just want to know when those are and if you've [P.E. teachers] done them. Yep, so we can get Channel 7 to come out and pass out the bracelets that they bought. We can make it look fancy and show we are talking about eating healthy even though, god I hate being in this situation. It's just more to appease, surface level. We're doing this and we're doing that. (Teacher D)

Teachers perceiving diminished district-level enthusiasm and support for the GSW program feel frustration with the district, reduce their motivation to implement the program, and decrease desire to adopt additional programs in the future.

Individuals and Communities Involved with GSW

Principal Support

Most of the teachers interviewed (five of seven) commended their principals for being supportive of the GSW program and other nutrition initiatives in Physical Education. Supportive principals are imperative to teacher motivation and success. Teachers commented on the benefit and effect of principals who dedicate their own time and energy to staying personally healthy. Two teachers without positive principal support felt overworked and under supported in their roles as GSW liaisons.

Teacher Enthusiasm and Motivation for GSW

Durlak (2008) emphasized the effect of key individuals on program implementation. In the case of GSW, physical education teachers have a large effect on program implementation and success. Out of seven physical education teachers interviewed, it was obvious that some teachers were more personally interested in nutrition than others. All teachers supported nutrition education on a theoretical basis, but some were more enthusiastic about nutrition education and the GSW program than others. Those teachers with higher personal motivation for GSW reported more time spent on GSW activities and lessons.

> First of all, I think it’s awesome. There is nothing negative to say about the program, I don’t think at all. And, I think it’s totally awesome and it makes kids take a second look at what, you know, what they’re eating. (Teacher G)

When another teacher was asked if she had low enthusiasm to implement yet another mandated program in her class:

> No, definitely not because I want the kids to have information. I wanted to have something put together that will give kids a purpose to eating and what a healthy diet is and that we're all on a diet that's called a healthy diet hopefully. Not a Hot Cheetos diet. A healthy diet is not a bad thing. A healthy diet is what we eat. (Teacher F)

Interestingly, Teacher F was one of the teachers with an unsupportive and unhelpful principal. Students benefit from her personal motivation for nutrition even amidst the absence of principal support and assistance. This particular teacher made a concerted effort to utilize the daily menus with GSW labels, stations with food cutouts and My Plate guidelines, guest speakers related to nutrition topics, and active games involving nutrition information in her class.

Other P.E. teachers were less enthusiastic about developing and delivering lesson plans with GSW information. This lower motivation was related to several specific things: the lack of time to develop resources or devote class time to "extra" curriculum, the desire to keep kids moving as much as possible during physical education, or the interviewer's perceived lack of teacher's personal interest in nutrition.

Another nutrition education program in Aurora Public Schools pays teachers a fairly sizeable amount of money to be liaisons between the program and the school. Teachers commented that this monetary incentive is quite effective at keeping teachers on track with following program outlines and activities. GSW has no such incentive, and this lack of incentive might be a detriment to program implementation given that other programs with incentives might be prioritized.

Student Responses to GSW: Fostering Enthusiasm and Pride

It is hard to evaluate overall student response to GSW because of the varied level of implementation and without district permission to ask students directly. However, one theme mentioned by several teachers was the creation of a sense of enthusiasm and pride among students in what they are eating at school as a result of GSW activities. Having a teacher who is excited about nutrition education and enthusiastic about the GSW program helps to foster enthusiasm in students.

> I wish you could watch. It's so funny. Kids would just come up and show me things in their lunch and bring them over and it was just really cool to see. I would have this little crowd around me just to show me that they drank all their milk. They would show me something from their brown bag and I would ask them if it was healthy, and then I'd make them justify why it was healthy. Just seeing how interested they were in showing, proving, asking questions, justifying, you know they're interested. (Teacher F)

After implementing GSW activities, this teacher notes:

> And now, the kids in the cafeteria, I mean, they call me over to look at their plates and in their lunch boxes. Oh, they are all about it. So, they are definitely empowered. (Teacher F)
>
> I had a kid come up to me saying I eat Hot Cheetos but I make sure I exercise afterwards, so there's a balance. (Teacher E)

Influence of Parents and Home Life on Food Intake

Four of seven teachers commented on the dissonance between the efforts to create a culture of wellness and good nutrition at school and the negative influence of parents and home life on wellness and food intake.

> It's like anything else, I mean you could work until midnight Monday through Friday but you go home on the weekends. Kids come back and they are definitely derailed from what you're trying to do and you don't have any control over that. (Teacher D)

Teachers commented on two negative family influences on nutrition: finances and nutrition knowledge/motivation. Six of the seven teachers interviewed teach at schools where more than 80% of students receive free or reduced price lunch. And two of those schools have more than 93% of students who receive free or reduced price lunch. Using qualification for free and reduced price lunch as a proxy for income, teachers at lower-income schools indicated that income strongly influences what parents buy at grocery stores. Families with lower incomes have less access to healthy foods.

> It's just that when you don't have a lot of money you don't have a lot of choices. And then a lot of them are limited to where they shop, how much they can spend, um, and then of course there's, you know, background of how they grew up and what they grew up on. (Teacher F)

The other family factors reported by teachers is a lack of parental nutrition knowledge and support for GSW principles along with strong cultural and oftentimes unhealthy influences on diet. Parents cook foods that are culturally familiar and those foods may be quite different than many of the healthy recipes served in Aurora Public Schools. One teacher commented that students are very unlikely to try foods at school that are so vastly different from foods cooked at home. Weekends, holidays, and summer vacations often derail the goals of the program because of family influences on what kids are eating.

Program Characteristics

Lack of Time

Six of seven interviewed teachers reported a lack of time to implement GSW activities and other district programs related to health and physical education. Many teachers were frustrated by the ongoing district mandate to implement new programs without allotting more time for physical education classes. Six of seven schools offer physical education one time per week, and one school offers PE every third day. Fifty minutes of class time per week is such a small increment of time, and teachers struggle to even find the time to deliver their curriculum standards.

> I mean, we touch on it [nutrition] here and there, but again there's so much to cover that it would be extra or if it came up and was applicable [we would talk about it]. (Teacher F)

Another teacher commented:

> You know we had another new program that I was kind of given this year not out of my own choice that I'm trying to fit in. And that's a program for fifth grade and it becomes difficult to fit more and more things into a curriculum that is already filled with standards and you know things that I think are important. (Teacher B)

Not only is there a paucity of class time for adequate curriculum delivery, there is also diminished planning time for teachers to create and organize GSW activities.

> But again, I'm having to take the time myself to create [program activities] when that should be coming, in my opinion, from either LiveWell Colorado or Aurora public schools. Somebody should be responsible for putting that together and getting that resource out to people. It shouldn't have to be a PE teacher to have to create things to do that. (Teacher A)

The seven teachers interviewed represent schools with varying numbers of extra nutrition programs. As outlined in Chapter III, elementary schools in Aurora may have up to five additional nutrition programs depending upon principal interest and average student/family SES. All schools in Aurora are also participating in the 5th Gear Nutrition Education program for 5th graders as of 2012-2013. The five optional nutrition education programs are:

- Breakfast in the Classroom
- Fresh Fruit and Vegetable Program
- INEP Nutrition Education
- Healthier U.S. Schools Challenge Award for implemented changes and activity time (not necessarily a program, but a commendation for changes and initiatives)
- Coordinated School Health.

The interviewed teachers whose schools have a larger number of these extra programs (>=3) are also the teachers with very strong comments about not having enough time to fit everything in. Comments from these three teachers with three or four additional nutrition programs related to lack of time included:

- Too many programs for the available time and money
- Lack of GSW implementation due to lack of time
- Not enough time to fit in general standards let alone extra curriculum.

Keeping Kids Moving During Class

Most of the interviewed teachers are worried about keeping their children moving instead of devoting time to sedentary nutrition lessons.

> I'm the one guy who gets them moving once a week one fifty-minute period. And so for me to sit and talk about anything I try to make it as quick as I can. It's necessary that I have to teach and show them things because they don't know everything coming into the building doors. So, that's something I'm not opposed to. But, I'd much rather play a game like healthy island where they're actually active and then I could debrief the game and combine it. (Teacher B)

> I think the program is great. Probably if I had more time or I saw the kids two or three times a week I could see myself using a fifteen minute block to talk about nutrition every class. . . . Even in fifty minutes trying to meet all those PE standards, this is between me and you, is very unrealistic. (Teacher B)

> My whole thing is the time. You know, I don't have enough time as a P.E. teacher in elementary to hit everything that we need to, to make them proficient. And, you think about reading and writing and how much time they're allowed in the classroom to really work at those skills. It's like you got these kids for forty-five minutes a week. Twenty-seven and a half hours throughout the year, and they're gonna know everything they're going to need to know in fifth grade to be healthy? (Teacher D)

Some teachers have creatively combined nutrition and GSW lessons with active games. This strategy involves a bit of extra planning for the teachers, but is a way to focus on nutrition information without sacrificing movement and physical activity time. Table 18 summarizes all of the identified themes from physical education teacher interviews. Note: The letters of the teachers in Table 18 correspond to the lettered identification of each quote in this section.

Table 18: Physical Education Teacher Interview Themes

Identified Themes	**Teacher/School Identifier and Year of GSW Initiation**						
	TeacherA-2010	TeacherB-2010	TeacherC-2010	TeacherD-2012	TeacherE-2012	TeacherF-2012	TeacherG-2011
Lack of District GSW Leadership/Not sure of Program Goals and Components	X		X	X	X	X	
Passing duties to someone else, or not sure who is responsible for what regarding GSW					X	X	
Big fuss for roll out, followed by waning enthusiasm and support at district level. No check-ins or communication.	X		X	X	X	X	
Lack of Details on Incentive Day	X	X	X	X			
Not enough time to do everything	X	X		X	X	X	X
Burdening P.E. Teachers/Teachers feel resentful of new programs and demands	X			X	X	X	
Want to spend time getting kids moving more than sedentary teaching	X	X	X			X	
Kids backslide in the evenings, weekends, and summers		X	X	X		X	
Need more collaboration/all school meetings about GSW/check-ins and accountability	X	X	X	X		X	
Kids have pride and enthusiasm for what they are learning and eating			X		X	X	
Support from Principal	X	X	X	X			X

CHAPTER VI

DISCUSSION

This study aimed to identify the influence of the Go, Slow, Whoa nutrition education program combined with Scratch Cooking Cafeteria Changes on elementary students' choices and dietary intake related to healthy foods. Specifically, this study investigated student choices and food consumption in schools with GSW and comparison schools without GSW. Qualitative research components helped outline differences in dose and implementation of the GSW program in relation to quantitative results. The goal of this research was to systematically evaluate the Go, Slow, Whoa program and cafeteria changes in Aurora Public Schools and to assist GSW administrators and funders with program improvement and funding recommendations.

Several key findings emerged from this mixed methods study. First, there were almost no significant differences between GSW schools and non-GSW comparison schools in both nutrients taken and nutrients consumed at school lunch. The only significant difference revealed more students in GSW schools choosing white milk over chocolate milk or no milk as compared to students in non-GSW schools. Second, various implementation issues were identified by physical education teachers that interfered with program success. And third, students consumed considerably fewer calories than they took in the lunch line (553 vs. 292 calories) and they took and consumed different amounts of nutrients each day.

GSW Program Effect on Nutrients Taken and Nutrients Consumed

The only significant difference between GSW and non-GSW schools was a higher odds ratio of choosing white milk over chocolate milk or no milk for students in GSW schools. The other variables that approached significance for GSW schools and students were drinking more milk, taking and consuming less fiber, taking and consuming more total fat, and taking and consuming more saturated fat. If the GSW program were having an effect, GSW school students would be expected to have the opposite choice and consumption of fiber, total fat, and saturated fat. These results indicate lack of a program effect on student consumption of more fruits and vegetables and fiber and less fat and saturated fat. Given the qualitative findings that huge implementation issues are influencing the success of the GSW program, one cannot declare a lack of program success due to the program nor discuss specific flaws in the program. However, data do show a lack of program success due to a program that was not implemented with fidelity and consistency.

Qualitative analyses reveal significant program implementation and success issues related to teachers, students, families and program support. These issues are summarized in the qualitative results and include class contact hours, teacher motivation and enthusiasm, family knowledge and support, and administration support and assistance. In order for health education to be successful, adequate class contact hours are imperative. The Go, Slow, Whoa program is rooted in the well-studied CATCH program which involves 47, 40-minute nutrition lessons (Perry, Bishop, et al., 1998). Based on a meta analysis of nutrition education studies, researchers recommend 50 hours of nutrition education per year to impact attitudes and behavior (Lytle, 1994). Teachers interviewed for this research reported far fewer than 50 hours of GSW and nutrition education programming in their schools. Two teachers reported less than 20 minutes per month of class time devoted to GSW, which would equate to less than three hours per school year.

Physical education teachers are devoting too little time to nutrition education to effect positive change in attitudes and behavior.

The meta analysis by Lytle et al. of nutrition education programs also indicated the importance of a family involvement component to influence nutrition attitudes and behaviors (Lytle, 1994). While the GSW program did include a parent breakfast to inform parents of the program and GSW model of food categorization, there were no additional program components or specific lessons involving families. Teachers perceived that lack of healthy nutrition reinforcement at home, due to both income constraints and lack of knowledge, as negatively influencing GSW program success.

Broader identified implementation issues relate to programming load, teacher burnout, and curriculum standards in Aurora Public Schools. P.E. teachers in APS are feeling overburdened and also feel like many health and physical activity programs do not receive the attention from administrators and classroom teaching time that they deserve or need to have an effect. Exploring and working on these time and burden issues at a policy level within the district could have important implications for special program effects (i.e. Go, Slow Whoa) in physical education and other subjects. Targeting and changing food consumption through nutrition education programs fits within a Social Ecological Model and comments by APS teachers encourage addressing a lack of program effect at multiple levels (Contento, 2011), but specifically starting at the policy and system level (S.N. Moore, Murphy, & Moore, 2011). Using a social ecological model of nutrition education not only targets policy issues related to allowable food in schools, vending machine regulations, and snack/party policies, but also relates to policy and structure associated with adequate instruction and appropriate teacher workload.

Comments from physical education teachers delivering the GSW program revealed less than ideal teacher enthusiasm, teacher knowledge of GSW and program goals, and support from Aurora administration. Physical education teachers are the individuals responsible for much of GSW delivery, and Aurora administration is responsible for reinforcing that delivery with technical assistance, leadership, and support. Teachers or individuals responsible for delivering a program and the delivery and support system available to them are crucial to program implementation and success (Durlak & DuPre, 2008). Lack of GSW implementation and program success results in part from these issues with teachers delivering the program and the administration responsible for supporting teachers.

Effect of Scratch Cooking Changes

Given that the school district follows very strict federal guidelines for calories and other nutrients in a standard elementary school lunch (550-650 calories daily) and given that students are consuming only about half of the calories in their school lunch, the reality is that different menu items hold varying appeal for students. Students respond to internal motivation, external motivation and taste in deciding what foods and how much of each food to choose and consume at school each day.

Students are taking and consuming vastly different amounts of nutrients each day and across days at lunch. Students consumed an average of 292 calories from school lunch out of 553 total tray calories. This reveals some important issues with school lunches in Aurora Public Schools. The amount of nutrients that are thrown away is alarming given that the body and brain will function better in school with adequate nourishment. The volume of trash also indicates a waste of district and federal funding if food is thrown away. Observation and interviews by researchers revealed several possible reasons for this waste in Aurora Public Schools: lack of time to finish lunch, upset stomach from recess before lunch, eagerness to get outside to play in schools with recess after lunch, and dislike of foods based on visual or taste cues. Previous research supports the interaction of physical, temporal, and social characteristics in a child's eating experience (S. N. Moore, Murphy, Tapper, & Moore, 2010). Including qualitative data from students would help reveal the different factors affecting eating habits at lunch.

Characteristics of Students in Aurora

Several teachers mentioned healthy food access issues of families within their schools due to low income and financial issues. Although Aurora has responded with several creative nutrition programs to deliver additional fresh fruits and vegetables at school, many families are not promoting healthy eating at home. The social determinants of health of Aurora students, the circumstances in which people are born and grow up, are certainly affecting their nutrition and health status. Research has linked poverty to obesity (Li & Hooker, 2010), but the results of this study do not indicate an overconsumption of calories from school lunch. The National School Lunch Program dictates that K-5 students should be receiving an average of 550-650 calories at lunch per day. However, based on this research students are taking an average of 553 calories at lunch, but only consuming 293 calories. This points to a bigger issue given that a large number of Aurora elementary students are obese. If they are eating so few calories at school, then the bulk of their calories are coming from afterschool snacks and meals served at home. The social determinants of health could be related to increased availability of high fat, high sugar and high calorie foods at home. The scratch cooking changes initiated in APS could be unappealing to students, and they could opt to eat less of their school lunch in favor of more desirable foods outside of school.

Conclusion

The quantitative findings of this research were enhanced by the qualitative analysis, which helped explain the lack of observed program effects. The quantitative analysis showed almost no GSW program effect, while the qualitative analysis uncovered important and related implementation issues. Qualitative analyses revealed markedly more varied class time devoted to Go, Slow, Whoa than projected by GSW administrators. This range of class time devoted to GSW activities helps explain the lack of program effect on food and nutrients taken and consumed at lunch.

The Go, Slow, Whoa program is rooted in the well-studied CATCH program (Perry, Bishop, et al., 1998). However, the CATCH program involved 31 total contact hours (47, 40-minute lessons) whereas the GSW program in Aurora Public Schools amounted to a fraction of that amount. Some teachers reported as little as three classroom contact hours per year of GSW curriculum. Without fidelity in implementation and a similar and recommend program dose, it is impossible to draw conclusions about the Go, Slow, Whoa program.

This research discovered several implementation and programmatic issues, namely unclear program goals and expectations, lack of time to prepare and deliver curriculum, P.E. teacher desire to keep kids moving during class, low teacher enthusiasm and motivation for new curriculum, and lack of district support and technical assistance. These compounded issues contributed to the lack of program implementation and program effect. Although a program effect was not found, the quantitative analysis revealed the characteristics of student lunch trays on three different days in Aurora Public Schools. Students consumed about half of what they took in the lunch line, took an average of 1.3 fruits and vegetables and consumed about 2 grams of fiber at lunch. Only 17% of students chose white milk (over no milk or chocolate milk) at lunch, and students taking all types of milk only consumed 50% of their milk. This information will be helpful as administrators make decisions about recipes, ordering, and planning. Given that the GSW program targets white milk, fruit and vegetable, and high fiber food consumption, these data could be used as baseline data for future GSW research if implementation of the program is improved.

Limitations

Plate Waste Methodology

Digital Plate Waste methodology has some limitations. The pre-meal weight/size of particular entrees and items were estimated from a sample of three collected items, and not actual weights of each student tray. Students might have eaten differently knowing their tray had been tagged and researchers were interested in their food patterns and consumption. Some trays were "played with", which made it difficult to photograph and accurately assess individual items.

Matching Techniques

Even though 11 variables were included in matching models, it is still possible that additional important covariates related to treatment assignment were missing from the analysis (i.e. unobserved). If this is the case, propensity scores could be biased. Shadish and Steiner (2010) warn that careful and detailed attention to identifying background covariates that could be related to treatment selection is imperative in propensity score analysis. One of the limitations of using propensity score matching for this research was the lack of detailed and similar information across elementary schools in Aurora.

Nearest neighbor, or nearest school in this research, propensity score matching is a commonly used matching algorithm. However, this method faces the risk of imprecise matches if the nearest neighbor is numerically quite distant (Baser, 2006). This limitation could be exacerbated by the small sample size of potential comparison schools in Aurora.

Small sample size is related to several other limitations of the matching methods used in this research. Propensity score methods generally work better in larger samples, because smaller samples can have substantial imbalances of some covariates even when using propensity score matching (Zhao, 2004). A small sample size (n=25 level 2 units in this study) also increases the risk of overspecification when using a large number of predictors in a propensity score logit model. In one study, propensity score methods (one-to-one matching and other matching techniques) were not superior to covariate matching (Mahalanobis) for small sample sizes (n=500), but performed better for larger sample sizes (n>1000), whereas Mahalanobis matching appears to be robust with small and large sample sizes n=500 and n>1000) (Zhao, 2004). There is a paucity of research on matching techniques in very small sample sizes such as this sample of 25 schools. There are 32 elementary schools in Aurora, but 7 schools started the GSW program in 2010 or 2009. Therefore, 25 schools were included in the current study sample for quantitative data collection. Of those 25 schools, 5 schools were GSW schools and 20 schools were possible control schools. Because of this very small sample size, several different propensity score models and matching techniques were utilized and resulting matches were checked for balance and mean differences on covariates to determine the best fitting model and matching technique.

If the matching methods introduced bias into the results, the direction and magnitude of the biases are unknown. These biases could have masked a true program effect, although this is unlikely given the qualitative findings regarding program implementation. In future studies employing matching techniques based on district data, interviewing staff at intervention and comparison schools could help identify additional factors that could be missing in objective and robust matching techniques.

Data Collectors

Using 100 data collectors enabled data to be collected from 10 different schools on the same day. Detailed and comprehensive data collection trainings were presented to one lead data collector at each school to ensure as much consistency and control over data collection. Lead data collectors utilized a protocol checklist and protocol fidelity questionnaire each day of data collection to increase adherence to data collection protocols.

Qualitative Data Collection

This research did not employ objective, quantitative measures of implementation. Information regarding dose and fidelity of implementation was gathered from qualitative interviews. Teachers could have tailored answers to implementation questions to match the administration’s expectations of GSW implementation. To minimize this bias, I assured teachers of the anonymity of their answers and utilized a semi-structured interview guide. Follow-up questions in the interview were tailored to each teacher to gather as much relevant and honest information regarding implementation as possible.

Generalizability

Because the study was conducted in a metropolitan area of Colorado, the ability to generalize results to other geographic locations and school districts is limited.

Significance and Directions for Future Research

As the number of obese and overweight children and the consumption of fat, sugar, sodium and processed foods outside of school continue to grow, effective nutrition policies and programs delivered during school will continue to be a priority. Given limited funding and class time, schools and districts must make smart decisions regarding nutrition programs. The results of this research indicate that programs are only as good as their implementation.

After tweaking the delivery and support for the Go, Slow, Whoa program, more research in Aurora Public Schools should focus on program dose, fidelity, and implementation. On a broader level, many research studies could benefit from quantitatively measuring implementation. Specifically, future research should include quantitative implementation data as predictors in regression models. Newton and Llosa encourage evaluators to investigate important questions such as how the quality of program implementation relates to different program outcomes and whether program effectiveness varies by setting, conditions, or other characteristics (Newton & Llosa, 2010). Using predictor variables related to implementation in a regression model could help determine “what works” in a particular program.

This study looked at only three days and found significant differences between days for white milk taken, fiber taken and consumed, fat and saturated fat taken and consumed, and fruits and vegetables taken. Those differences are likely related to the menu choices for each day of the study (beef stew and biscuits; chicken, roll, baked beans and cake; pizza, green beans and grapes). Students consumed less fiber on days 2 and 3, which could be a result of increased desire to eat the low fiber entrée (chicken or pizza) or cake, and therefore lower desire or less stomach room to eat additional high-fiber fruits and vegetables and side items. Or, perhaps it takes longer to eat chicken as a result of having to pick it up or cut it, so there is less time to eat other high fiber sides on the tray. Students also took less fruits and vegetables on days 2 and 3, which could signify that they prefer the main entrée and side options more on those days and pass by the salad bar and additional fruits and vegetables. Or, perhaps the quality of the fruits and vegetables was lower later on in the week as a weekly produce shipment aged. Our study days were Wednesday, Thursday, and Friday. Students consumed more total fat and saturated fat on days 2 and 3 compared to day 1, which could be a function of them liking the chicken (with skin) and pizza (with cheese) more than they like beef stew. Cake was also served on day 2, which added fat consumption for most students in the cafeteria. Future research should investigate why students eat and don't eat certain foods on their lunch trays in order to outline the reasons for observed plate waste data in this research. Nutrition Services would benefit from a more thorough assessment of the likability and consumption of different menu items in their menu cycle. APS should consider using qualitative interviews or focus groups with students to gather additional information.

Students would provide rich data on perceptions and impact of the program and scratch cooking changes.

Aurora Public Schools would also benefit from increased communication with and incentives for teachers implementing the Go, Slow, Whoa program. Physical education teachers mentioned several possible strategies to improve GSW, including monthly meetings of physical education teachers, monetary incentives to complete program components, and increased support from school administrators for teachers to attend nutrition education professional development. APS and LiveWell Colorado should consider available resources, both monetary and personnel, in the context of these findings and recommendations before deciding how to improve, if at all, the GSW program.

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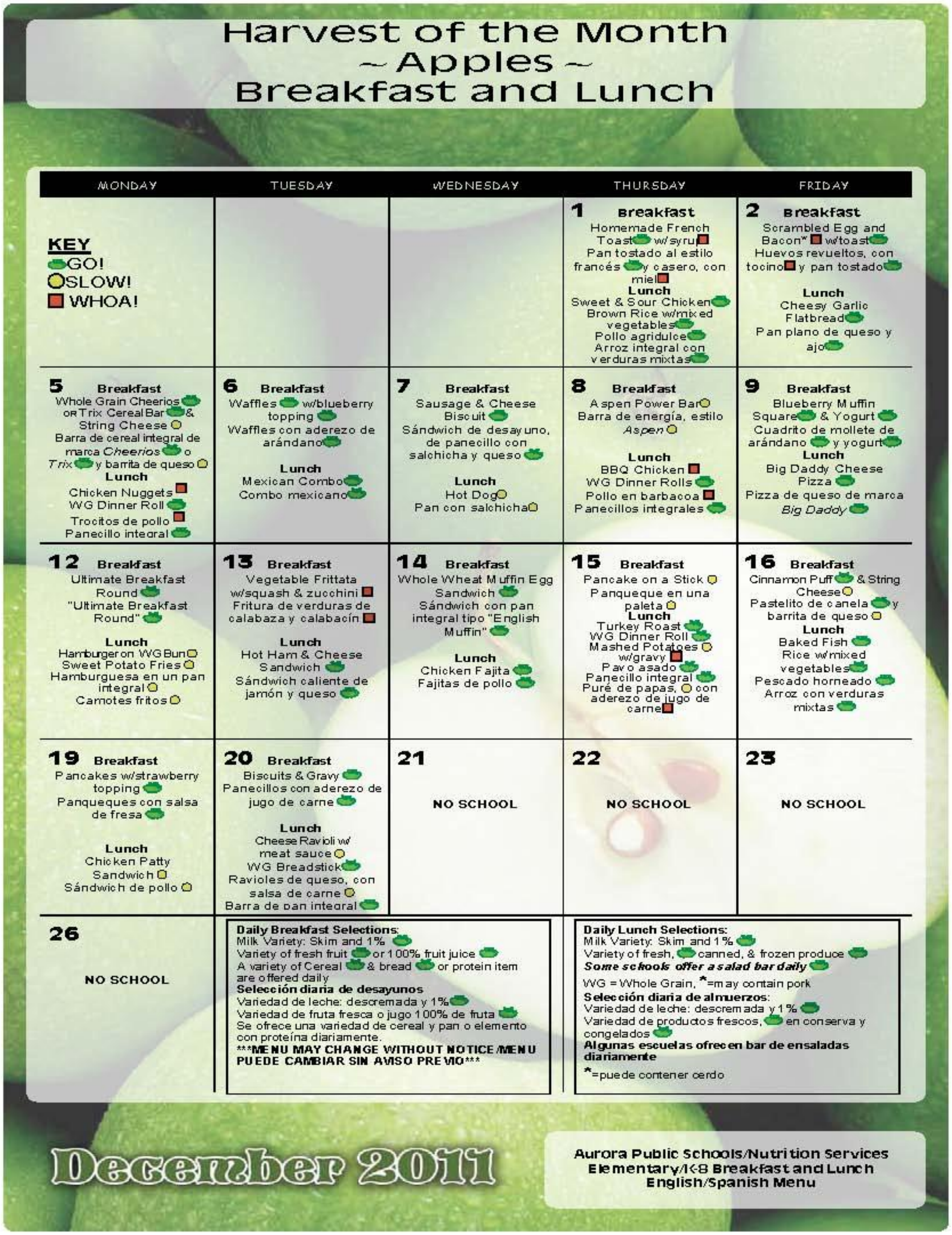
Appendix A: Aurora Public School Sample Menu-December 2011



Harvest of the Month
~ Apples ~
Breakfast and Lunch

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
KEY 🍏GO! 🟡SLOW! 🟥 WHOA!			**1** **Breakfast** Homemade French Toast🍏 w/syrup🟥 Pan tostado al estilo francés 🍏y casero, con miel🟥 **Lunch** Sweet & Sour Chicken🍏 Brown Rice w/mixed vegetables🍏 Pollo agridulce🍏 Arroz integral con verduras mixtas🍏	**2** **Breakfast** Scrambled Egg and Bacon* 🟥 w/toast🍏 Huevos revueltos, con tocino🟥 y pan tostado🍏 **Lunch** Cheesy Garlic Flatbread🍏 Pan plano de queso y ajo🍏
5 **Breakfast** Whole Grain Cheerios🍏 or Trix Cereal Bar🍏& String Cheese 🟡 Barra de cereal integral de marca *Cheerios*🍏 o *Trix*🍏y barrita de queso🟡 **Lunch** Chicken Nuggets🟥 WG Dinner Roll 🍏 Trocitos de pollo🟥 Panecillo integral 🍏	**6** **Breakfast** Waffles🍏 w/blueberry topping 🍏 Waffles con aderezo de arándano🍏 **Lunch** Mexican Combo🍏 Combo mexicano🍏	**7** **Breakfast** Sausage & Cheese Biscuit 🍏 Sándwich de desayuno, de panecillo con salchicha y queso 🍏 **Lunch** Hot Dog🟡 Pan con salchicha🟡	**8** **Breakfast** Aspen Power Bar🟡 Barra de energía, estilo *Aspen*🟡 **Lunch** BBQ Chicken 🟥 WG Dinner Rolls 🍏 Pollo en barbacoa 🟥 Panecillos integrales 🍏	**9** **Breakfast** Blueberry Muffin Square🍏 & Yogurt 🍏 Cuadrito de mollete de arándano 🍏 y yogurt🍏 **Lunch** Big Daddy Cheese Pizza 🍏 Pizza de queso de marca *Big Daddy*🍏
12 **Breakfast** Ultimate Breakfast Round🍏 "Ultimate Breakfast Round"🍏 **Lunch** Hamburger on WG Bun🟡 Sweet Potato Fries🟡 Hamburguesa en un pan integral🟡 Camotes fritos🟡	**13** **Breakfast** Vegetable Frittata w/squash & zucchini 🟥 Fritura de verduras de calabaza y calabacín 🟥 **Lunch** Hot Ham & Cheese Sandwich 🍏 Sándwich caliente de jamón y queso 🍏	**14** **Breakfast** Whole Wheat Muffin Egg Sandwich 🍏 Sándwich con pan integral tipo "English Muffin" 🍏 **Lunch** Chicken Fajita🍏 Fajitas de pollo 🍏	**15** **Breakfast** Pancake on a Stick 🟡 Panqueque en una paleta 🟡 **Lunch** Turkey Roast🍏 WG Dinner Roll 🍏 Mashed Potatoes 🟡 w/gravy 🟥 Pavo asado🍏 Panecillo integral 🍏 Puré de papas, 🟡 con aderezo de jugo de carne🟥	**16** **Breakfast** Cinnamon Puff🍏 & String Cheese🟡 Pastelito de canela🍏y barrita de queso 🟡 **Lunch** Baked Fish 🍏 Rice w/mixed vegetables🍏 Pescado horneado 🍏 Arroz con verduras mixtas 🍏
19 **Breakfast** Pancakes w/strawberry topping🍏 Panqueques con salsa de fresa🍏 **Lunch** Chicken Patty Sandwich 🟡 Sándwich de pollo 🟡	**20** **Breakfast** Biscuits & Gravy 🍏 Panecillos con aderezo de jugo de carne🍏 **Lunch** Cheese Ravioli w/ meat sauce🟡 WG Breadstick🍏 Ravioles de queso, con salsa de carne 🟡 Barra de pan integral🍏	**21** **NO SCHOOL**	**22** **NO SCHOOL**	**23** **NO SCHOOL**
26 **NO SCHOOL**				

Daily Breakfast Selections:
Milk Variety: Skim and 1% 🍏
Variety of fresh fruit 🍏or 100% fruit juice 🍏
A variety of Cereal 🍏& bread 🍏 or protein item are offered daily
Selección diaria de desayunos
Variedad de leche: descremada y 1%🍏
Variedad de fruta fresca o jugo 100% de fruta 🍏
Se ofrece una variedad de cereal y pan o elemento con proteína diariamente.
*****MENU MAY CHANGE WITHOUT NOTICE/MENU PUEDE CAMBIAR SIN AVISO PREVIO*****

Daily Lunch Selections:
Milk Variety: Skim and 1% 🍏
Variety of fresh, 🍏canned, & frozen produce 🍏
Some schools offer a salad bar daily 🍏
WG = Whole Grain, *=may contain pork
Selección diaria de almuerzos:
Variedad de leche: descremada y 1% 🍏
Variedad de productos frescos, 🍏 en conserva y congelados 🍏
Algunas escuelas ofrecen bar de ensaladas diariamente
*=puede contener cerdo

December 2011

Aurora Public Schools/Nutrition Services
Elementary/K-8 Breakfast and Lunch
English/Spanish Menu

Appendix B: Go Slow Whoa Rating System

(Coordinated Approach to Child Health (CATCH), 2012)

The CATCH Go-Slow-Whoa List is a tool to guide children and families toward making healthful choices. The overall message is that all foods can fit into a healthful diet, which consists of more GO foods than SLOW foods, and more SLOW foods than WHOA foods.

NOTE: Aurora Public Schools used the following tables to guide the labeling of menu items as Go, Slow, or Whoa foods. Menu items might have individual components (i.e., bread, meat, dressing, cheese) from different categories, and thus the overall food is given an average rating by APS Nutrition Services staff and put into a Go, Slow, or Whoa food category.

Foods are divided into seven sections, 5 of which are food groups (Vegetables; Fruits; Grains; Milk and Dairy Foods; Meat, Beans, and Eggs) and two of which are Fats and Other.

GO foods: Examples include fruits and vegetables, whole-grain foods, and unsweetened 1% milk. **GO** foods are commonly described as whole foods, meaning that they are generally the least processed compared to foods in the same food group/section. These foods are also lowest in salt (sodium) and/or added sugars. In addition, **GO** foods are lowest in unhealthy fats (i.e. solid fats such as butter or lard) as opposed to healthy fats, which are vegetable oils.

WHOA foods: Examples include candy, cookies, chips, fried foods, ice cream, soft drinks, and sugary cereals. **WHOA** foods are generally the most processed and are highest in unhealthy fats, added sugars, and/or salt.

SLOW foods are in between **GO** foods and **WHOA** foods. Examples include sweetened (including flavored) 1% milk, refined-grain foods, and fruit with added sugar.

To determine whether a food is **GO, SLOW,** or **WHOA**, it is compared to all the other foods in its category (row) of the food group/section. Although foods are categorized in this way, it is important to note that eating large quantities of foods can be unhealthy, even if they are **GO** foods. The **GO–SLOW–WHOA List** does not contain combination foods such as sandwiches or pizzas since each ingredient is either a **GO, SLOW,** or **WHOA** food. For instance, a pizza is made up of a crust, sauce, cheese, and toppings. These ingredients belong in more than one food group. To determine if the pizza is a **GO, SLOW,** or **WHOA** pizza, you should take all the ingredients into consideration.

The most healthful type of meal includes mostly GO foods. Here are two examples:

GO Breakfast

Oatmeal without added sugar (GO)
Brown sugar (WHOA)
Fresh Blueberries (GO)
1% milk (GO)

Go Lunch

Turkey sandwich
Whole-wheat bread (GO)
Turkey without skin (GO)
    Mustard (GO)
    American cheese (WHOA)
    Tomato (GO)
    Lettuce (GO)
    Baked potato chips (SLOW)
    Canned peaches (no added sugar) (GO)
    Skim Milk (GO)

VEGETABLES

	GO	SLOW	WHOA
Vegetables	• Fresh, frozen, or canned vegetables with no salt, sugar, or fat added, or with a small amount of salt* added	• Fresh, frozen, or canned vegetables made with vegetable oils • Vegetables with salt and/or sugar added • Baked french fries and hash browns	• Fresh, frozen, or canned vegetables made with solid fats • Fried battered vegetables • Fried potatoes, fried french fries, fried hash browns
Vegetable Juice	• 100$ low-sodium vegetable juice	• 100$ vegetable juice	

* Less than 200 mg of sodium (about one pinch of salt) per cup

Examples of vegetables: asparagus, avocado, bean sprouts, beets, bok choy, broccoli, Brussels sprouts, cabbage, carrots, cauliflower, celery, chayote, collard greens, corn, cucumbers, eggplant, garlic, green beans, jicama, kale, lettuce, mushrooms, mustard greens, nopalitos, okra, onions, parsnip, peas, peppers (such as bell, jalapeno, poblano, etc.), potatoes, pumpkin, sweet potatoes, spinach, squash, taro root, tomatillos, tomatoes, turnip greens, turnips, yucca (cassava

FRUITS

	GO	SLOW	WHOA
Fruits	• Fresh, frozen, or canned fruits with no sugar or salt added, or with a small amount of salt* added	• Fruits canned in light syrup • Fruits with sugar and/or salt added	• Fruits canned in heavy syrup
Fruit Juice	• 100$ fruit juice • Frozen 100$ fruit juice bars and smoothies	• Sherbet, sorbet • Frozen fruit juice bars and smoothies with added sugar	
Dried Fruit/ Fruit Leather	• Dried fruit (such as raisins, figs, dates, apricots, plums) • 100$ fruit leather	• Dried fruit with added sugar • Fruit leather with added sugar	• Fruit roll-ups

* Less than 200 mg of sodium (about one pinch of salt) per cup

Examples of fruits: apples, apricots, bananas, blackberries, blueberries, cantaloupe, cherries, figs, grapefruit, grapes, honeydew melons, kiwi, kumquats, lemons, limes, mangos, nectarines, oranges, papaya, peaches, pears, persimmons, pineapple, plums, pomegranate, star fruits, strawberries, tangerines, watermelon

GRAINS

	GO	SLOW	WHOA
Breads/Muffins/ Sweet Breads	• Whole-grain bread, buns, rolls, bagels, tortillas, and pita bread • Corn tortillas	• White (refined flour) bread, buns, rolls, bagels, tortillas, pita bread • Cornbread • Muffins, waffles, pancakes, and French toast made with vegetable oils	• Croissants • Biscuits • Sweet rolls • Doughnuts • Muffins, waffles, pancakes, and French toast made with solid fats
Pasta	• Pasta made with whole-grain flour	• Pasta made with refined flour • Egg noodles	• Instant higher-fat noodle soups
Rice and Grains	• Brown rice • Wild rice • Whole grains (amaranth, barley, buckwheat, corn, whole cornmeal, millet, oats, quinoa, rye, sorghum, teff, triticale) • Whole wheat (spelt, durum, farro [emmer], cracked wheat, wheat berries, bulgur)	• White rice • Rice cakes	• Fried rice
Cereals	• Whole-grain, low-sugar cereals (such as toasted oats, shredded wheat, oatmeal, muesli)	• Low-sugar cereals made with refined grains • Granola made with vegetable oils • Instant oatmeal	• High-sugar cereals made with refined grains • Granola made with solid fats
Crackers	• Low-fat whole-grain crackers	• Low-fat crackers made with refined grains	• High-fat crackers
Chips	• Baked tortilla chips	• Tortilla chips • Baked potato chips • Pretzels	• Potato chips • Other chips (such as cheese puffs, corn chips)
Cookies/Cake	• Whole-grain animal crackers • Graham crackers	• Animal crackers made with refined flour • Vanilla wafers • Cereal/fruit bars	• Cookies • Cakes
Popcorn	• Air-popped popcorn with no salt added	• Popcorn made with vegetable oils and/or salt	• Popcorn made with solid fats • Flavored popcorn (such as caramel, cheese) • Kettle corn

MILK and DAIRY FOODS

	GO	SLOW	WHOA
Milk	• Fat-free (skim/non-fat) milk • 1$ (low-fat) milk • Fortified soy, almond, and rice milk – unsweetened • Non-fat dry milk	• 2$ (reduced-fat) milk • Flavored fat-free (skim/non-fat) or 1$ milk • Fortified soy, almond, and rice milk – sweetened	• Whole milk (plain or flavored) • Flavored 2$ (reduced-fat) milk • Milkshakes
Yogurt	• Fat-free or low-fat plain or 100$ fruit juice-sweetened yogurt • Fat-free or low-fat yogurt drinks – unsweetened	• Fat-free or low-fat yogurt – sweetened • Fat-free or low-fat yogurt drinks – sweetened	• Whole-milk yogurt • Whole-milk yogurt drinks
Cheese	• Part-skim natural cheese • Low-fat string cheese • Low-fat (1%) cottage cheese • Low-fat soy cheese	• Natural cheeses (such as Colby, cheddar, Swiss) • Cottage cheese (2$ or reduced-fat) • Ricotta cheese (part-skim) • Low-fat cheese sauce • Low-fat processed cheese • Soy cheese • Low-fat cream cheese • String cheese	• Processed cheese • Powdered cheese sauce mix • Cream cheese • Cheese sauce • Ricotta cheese (whole-milk) • Cottage cheese (whole-milk)
Sour Cream		• Low-fat sour cream	• Sour cream
Dairy Desserts		• Non-fat or low-fat frozen yogurt • Low-fat ice cream • Pudding made with skim or 1$ milk	• Ice cream • Pudding made with 2$ or whole milk • Cheesecake • Frozen yogurt • Gelato

MEAT, BEANS, and EGGS

- Less than 200 mg of sodium (about one pinch of salt) per cup

	GO	SLOW	WHOA
Dried Beans and Peas	• Beans (such as pinto, black red, garbanzo), peas (such as black-eyed, split, purple hull), and lentils – with no salt or fat added, or with a small amount of salt* added	• Beans, peas, and lentils made with vegetable oils • Refried beans • Beans, peas, and lentils with salt and/or sugar added • Hummus • Falafel	• Beans, peas, and lentils made with solid fats • Baked beans, canned • Pork and beans, canned
Nuts and Seeds	• Pumpkin and sunflower seeds with no added salt, sugar, or fat	• Pumpkin and sunflower seeds with added salt, sugar, and/or fat • Peanuts, almonds, pecans, walnuts, cashews, and pistachios with no added salt, sugar, or fat • Natural peanut butter and other nut butters	• Peanuts, almonds, pecans, walnuts, and pistachios with added salt, sugar, and/or fat • Peanut butter and other nut butters with added salt, sugar, and/or fat
Eggs	• Whole eggs • Egg whites • Egg substitute	• Eggs fried in vegetable oil	• Eggs fried in solid fats
Fish	• Fish and shellfish – baked, grilled or broiled (such as salmon, catfish, shrimp, crab, lobster) • Tuna canned in water	• Baked breaded fish, shellfish, and fish sticks • Tuna canned in oil	• Fried fish, shellfish, and fish sticks
Poultry	• Chicken and turkey without skin (baked, grilled, or broiled)	• Chicken and turkey with skin (baked, grilled, or broiled) • Breaded baked chicken and turkey • Baked chicken nuggets • Ground chicken and turkey	• Fried chicken • Fried chicken nuggets
Beef	• Lean cuts of beef (such as round roast, round steak, sirloin, tenderloin) • Extra-lean ground beef • Ground beef that has been drained and rinsed	• Lean ground beef • Lean or low-fat hamburgers • Regular cuts of beef (such as brisket, T-bone, chuck roast)	• Regular ground beef • Regular hamburgers • Ribs
Pork	• Lean cuts of pork (such as pork chops or tenderloin – without fat)	• Lean ham • Canadian bacon • Regular cuts of pork (such as pork roast, shoulder, ham)	• Ribs • Bacon • Ham hock • Pork skins
Other Protein Foods	• Tofu • Tempeh • Venison	• Veggie burger • Processed plant-based meat substitutes	
Processed Meat		• Luncheon meats (such as chicken, turkey, ham) • Low-fat hot dogs • Turkey or chicken sausage	• Hot dogs • Pepperoni • Sausage • Beef jerky • Bologna • Salami • Chorizo • Pastrami

FATS

	GO	SLOW	WHOA
Fats	• Non-stick cooking spray	• Vegetables oils (such as olive, canola, peanut, soybean, corn, cottonseed, safflower, or sunflower)	• Solid fats (such as butter, margarine, shortening, lard, salt, pork)
Foods Rich in Fats		• Gravy, sauces, mayonnaise, and salad dressing made with vegetable oils	• Gravy, mayonnaise, sauces, and salad dressing made with solid fats

OTHER

	GO	SLOW	WHOA
Herbs and Spices	• Fresh spices (such as garlic and ginger) • Fresh or dried herbs (such as basil, rosemary, cilantro) • Seasonings without salt (such as garlic powder or onion powder)		• Salt • Seasonings with salt or sodium • Monosodium glutamate (MSG)
Sugars/ Sweeteners/ Candy		• Reduced-sugar syrup • Artificial sweeteners	• Sugar • Brown sugar • Chocolate candy • Candies • Sugar-sweetened gelatin • Honey • Molasses • Syrup • Agave nectar
Beverages	• Water • Sparkling water • Unsweetened decaffeinated tea	• Unsweetened tea	• Soft drinks (regular and diet) • Beverages with added sugar • Sweetened tea and tea drinks • Coffee drinks • Sports drinks • Fruit-flavored drinks • Fruit-juice drinks • Vitamin water • Energy drinks
Spreads/ Condiments	• Mustard • Butter flakes	• Jam • Jelly • Olives • Ketchup	• Pickles

Appendix C: Matching Data

	# kids	Nat Amer	Asian	Black	Hisp	White	Nat. Haw.	Two Eth or >	frl	ell	gt	sped	np
	n	%	%	%	%	%	%	%	%	%	%	%	n
Altura ES	462	1.1	0.6	11.5	74.5	9.7	0.0	2.6	96.5	66.0	1.7	6.3	1
Arkansas ES	548	0.5	3.3	23.5	42.7	24.8	0.9	4.2	60.9	33.0	2.6	6.8	1
Aurora Frontier K-8	628	0.6	12.7	17.8	25.6	37.7	0.2	5.3	29.3	14.8	7.0	8.1	0
Century ES	344	0.6	4.4	27.3	34.0	27.9	0.6	5.2	68.3	27.9	2.9	10.8	0
Crawford ES	641	1.4	7.6	7.8	77.8	2.8	0.0	2.5	89.4	78.3	1.2	9.8	1
Dalton ES	521	1.3	6.3	14.8	32.6	40.7	0.2	4.0	52.0	19.6	7.5	12.9	0
Dartmouth ES	385	1.0	3.1	16.9	36.1	37.1	0.0	5.7	57.4	19.7	3.6	13.8	0
Elkhart ES	704	0.7	5.7	14.5	70.0	6.7	1.4	1.0	94.7	67.2	1.6	10.2	3
Fletcher Primary	382	0.5	2.1	5.2	88.5	2.4	0.0	1.3	93.2	83.5	1.0	6.3	2
Fulton ES	487	0.8	5.7	12.5	72.3	6.2	0.0	2.5	91.6	66.9	1.4	6.6	2
Iowa ES	467	0.9	4.3	23.3	42.0	25.9	0.4	3.2	73.0	35.1	3.2	9.9	0
Jewell ES	531	0.9	5.3	26.2	44.6	19.4	0.4	3.2	70.2	40.1	2.4	9.0	1
Kenton ES	553	0.5	2.0	9.0	81.2	5.1	0.4	1.8	87.9	74.3	2.5	11.2	1
Lansing ES	405	1.5	2.0	31.4	55.1	7.4	0.2	2.5	84.7	52.3	1.5	7.9	2
Lyn Knoll ES	28	0.3	1.0	26.6	64.7	5.9	0.0	1.4	88.9	64.0	2.1	5.2	1
Peoria ES	494	0.4	2.2	11.3	76.7	7.9	0.0	1.4	83.8	67.8	1.0	9.7	0
Sable ES	441	0.7	5.2	22.9	59.4	8.8	0.7	2.3	86.4	60.3	1.4	6.3	3

	# kids	Nat Amer	Asian	Black	Hisp	White	Nat. Haw.	Two Eth or >	frl	ell	gt	sped	np
	n	%	%	%	%	%	%	%	%	%	%	%	n
Sixth Avenue ES	610	0.3	2.3	18.2	71.3	5.4	0.5	2.0	89.2	62.8	2.3	8.0	3
Vanguard	508	0.6	2.2	15.4	51.8	27.2	0.0	3.0	55.7	32.9	1.0	12.8	0
Vassar ES	550	0.2	4.5	22.7	38.2	29.6	0.4	4.4	59.3	23.1	2.7	12.7	0
Vaughn ES	498	0.8	1.0	14.1	71.5	9.8	1.0	1.8	85.9	61.6	2.0	5.8	0
Virginia Court	474	0.6	3.6	15.6	71.1	7.4	0.0	1.7	85.2	65.0	0.4	7.8	1
VISTA Peak P-8 Exploratory	803	0.6	1.2	14.7	38.1	42.0	0.1	3.2	48.8	22.0	3.0	7.6	1
Wheeling ES	613	1.5	3.8	17.5	61.8	12.1	0.2	3.3	81.9	51.5	1.8	9.3	0
Yale ES	501	1.0	2.6	18.4	50.7	25.5	0.0	1.8	69.9	43.7	2.6	6.0	0

Appendix D: Qualitative Semi-Structured Interview Guide

1. What year did you kick off the GSW program? _____________
2. Tell me about the nutrition knowledge and food intake of the kids in your school. (Prompt for attitudes, motivation, knowledge, peers, role modeling, etc.)
3. Tell me about the Scratch Cooking Cafeteria Changes in your school. (Prompt for what the teachers know, what they have seen, what the kids might tell them about changes.) What do students like and dislike about recent cafeteria/menu changes?
4. Tell me about your experience with the Go, Slow, Whoa program.
5. What do your students like and dislike about the GSW program?
6. What parts of the GSW program are confusing to kids?
7. In your opinion, what grade levels understand and/or like the program most? Why?
8. Do you think you are adequately prepared to deliver the GSW curriculum? Why?
9. How much education/training do you have in nutrition ed? Please describe your training.
10. How much time do you spend "prepping" for nutrition ed lessons?
11. How much time did you spend GIVING GSW lessons throughout this past school year? (# of hours per week or per month)
12. What methods or strategies have you used to deliver GSW programming?
13. Did you deviate from supplied lessons, or deliver them "as is"?
14. In your opinion, what are the strengths and weaknesses of the GSW program?
15. If you were an administrator, would you want GSW at your school? Would you want to continue or make more scratch cooking changes? (prompt with: are these two interventions a good use of time and money?)

Appendix E: Field Notes

Field Notes Recording Sheet for lead data collectors:

Wednesday, April 18

1. Pre-Lunch Question: What types of milk are available before the start of lunch? (i.e. skim white, skim chocolate, 1% white)
2. Pre-Lunch Question: What is available in the salad bar at the start of lunch?
3. Pre-Lunch: What, exactly, is offered in the hot lunch line today? (This is redundant with the samples, but I just want to be sure we are aware of everything.)
4. Pre-Lunch: Do you see any Go, Slow, Whoa labels on the hot lunch line foods (Red, Yellow, or Green circles/squares/triangles)?
5. Post-Lunch: What type of milk is available at the end of your last lunch shift of the day?
6. Notes about cafeteria environment: (i.e. GSW posters? Describe interaction between staff and students at lunch. What are students talking about and doing at lunch (i.e. socializing vs. eating? Hurrying to get outside and play? Trading food?)

Appendix F: Interrater Reliability Kappa Coefficients

Day 1 Interrater Reliability

Variable	Kappa	Kappa AFTER 3rd Rater Reconciliation
Grade	1	1
Male	0.98	1
Type of Milk Taken	0.94	1
Ounces of Milk Left	0.97	1
Took Beef?	0.9	1
% Beef Left	0.37	0.39
Took Biscuit?	0.96	1
% Biscuit Left	0.56	0.58
Took Apple?	0.89	1
% Apple Left	0.4	0.43
Took Peas?	0.91	1
% Peas Left	0.4	0.41
Took Pears?	0.9	1
% Pears Left	0.47	0.54
Took Broccoli?	0.78	1
% Broccoli Left	0.35	0.49
Took Carrots?	0.96	1
% Carrots Left	0.23	0.2
Took Plum?	1	1
% Plum Left	0.07	0.07
Took Broccoli?	0.91	1
Took Carrots?	0.92	1
Took Celery?	0.86	1
Took Cherry Tomatoes?	0.93	1
Took Chick Peas?	1	1
Took Cucumbers?	0.8	1
Took Spinach or Lettuce?	0.91	0.97
Took Apple?	0.82	0.96
Took Raisins	0.89	1
Took Strawberry?	0.99	1
Took Cantaloupe?	0.93	1
Took Black Beans?	0.67	1
Took Chicken?	0.85	1

Day 2 Interrater Reliability

Variable	Kappa	Kappa AFTER 3rd Rater Reconciliation
Grade	0.99	1
Male	0.96	1
Type of Chicken Taken	0.51	0.99
% Chicken Left	0.32	0.32
Cake Taken?	0.98	1
% cake left	0.5	0.51
Baked Beans Taken?	0.97	1
% Baked Beans left	0.53	0.55
Green Beans Taken?	0.99	1
% Green Beans Left	0.42	0.42
Roll Taken?	0.96	0.99
% Roll Left	0.63	0.66
Carrots taken?	0.83	1
% Carrts left	0.46	0.55
Applesauce Taken?	0.95	1
% Applesauce left	0.19	0.22
Orange Taken?	0.99	0.99
% Orange Left	0.46	0.47
Peach Taken?	0.88	1
% Peach Left	0.48	0.86
Type of Milk Taken	0.98	1
Ounces of Milk Left	0.97	1
Broccoli Taken?	0.84	1
Cauliflower Taken?	0.67	1
Celery Taken?	0.97	1
Cherry Tomato Taken?	1	1
Cucumber Taken?	0.92	1
Spinach/Lettuce Taken?	0.93	1
Raisins Taken?	0.8	1
Strawberries Taken?	1	1
Cantaloupe Taken?	0.88	1
Black Beans Taken?	1	1

Day 3 Interrater Reliability

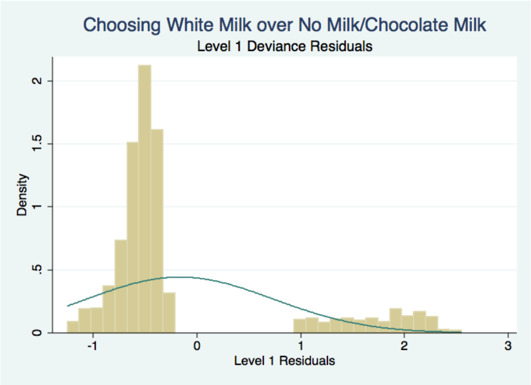
Variable	Kappa	Kappa AFTER 3rd Rater Reconciliation
Grade	0.98	1
Male	0.94	1
Pizza Taken?	1	1
% Pizza Left	0.29	0.3
Cucumber Taken?	0.89	1
% Cucumber Left	0.2	0.28
Grapes Taken?	0.97	1
% Grapes Left	0.58	0.61
Green Beans Taken?	0.96	1
% Green Beans Left	0.54	0.56
Broccoli and Carrots Taken?	0.92	1
Broccoli and Carrots Left	0.25	0.25
Pineapple Taken?	0.59	1
Pineapple Left	0.38	0.47
Cake Taken?	0.74	0.99
Cake Left	0.49	0.49
Watermelon Taken?	0.35	1
Watermelon Left	0.09	0.16
Cauliflower Taken?	0.94	1
Cauliflower Left	0.27	0.43
Type of Milk Taken	0.96	1
Ounces of Milk Left	0.93	1
Broccoli Taken?	0.96	1
Cauliflower Taken?	0.41	1
Carrots Taken?	1	1
Celery Taken?	0.97	1
Cherry Tomatoes Taken?	1	1
Chick Peas Taken?	1	1
Cucumber Taken?	0.88	1
Spinach/Lettuce Taken?	0.95	1
Kiwi Taken?	0.99	1
Raisins Taken?	1	1
Strawberries Taken?	1	1
Cantaloupe Taken?	0.99	1
Black Beans Taken?	1	1
Chicken Taken?	0.43	1
Tropical Salad Taken?	0.83	0.96
Orange Taken?	0.84	1
Cake Taken?	0	1
Peach Taken?	0.95	1
Yogurt Taken?	0.96	1
Banana Taken?	0.91	1
Pear Taken?	0.7	1
Pineapple Taken?	0.75	1

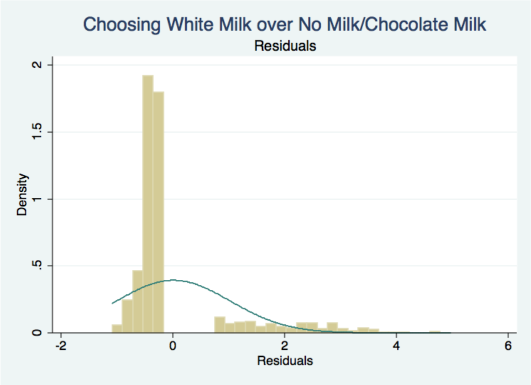
Appendix G: AIC and BIC for Random Intercept and Random Coefficient Models

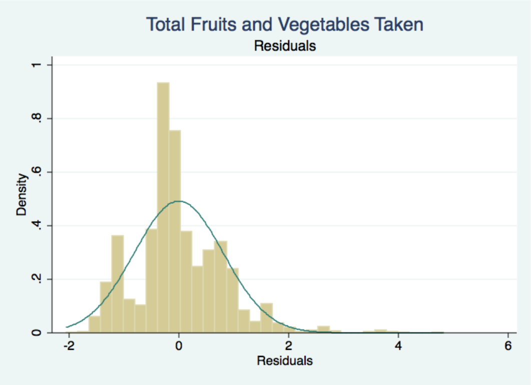
	AIC Random-Intercept Model	AIC Random-Coefficient Model	BIC Random-Intercept Model	BIC Random-Coefficient Model
Choosing White Milk over Choc Milk/No milk	1790	1791	1835	1842
Choosing White Milk over Choc Milk	1697	1696*	1741	1746
Total FV Taken	5117	5119	5167	5175
Total Fiber Taken	7270	7272	7321	7329
Total Fiber Consumed	7403	7405	7454	7461
Total Fat Taken	12128	12130	12179	12186
Total Fat Consumed	13140	13143	13192	13199
Total Saturated Fat Taken	7349	7351	7399	7408
Total Saturated Fat Consumed	8687	8689	8738	8746

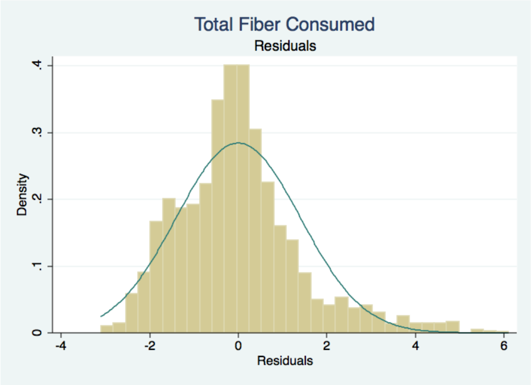
* The only information criteria test of all models where the Random-Coefficient Model showed a better fit than the Random-Intercept Model.

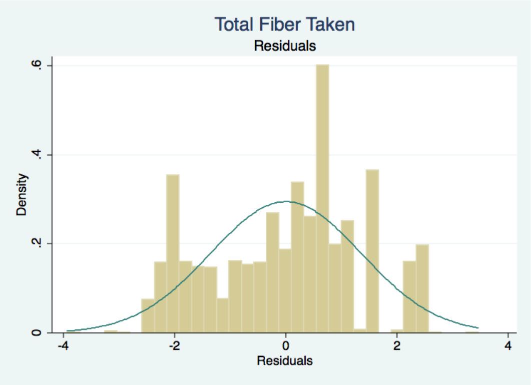
Appendix H: Residual Graphs for Final Models

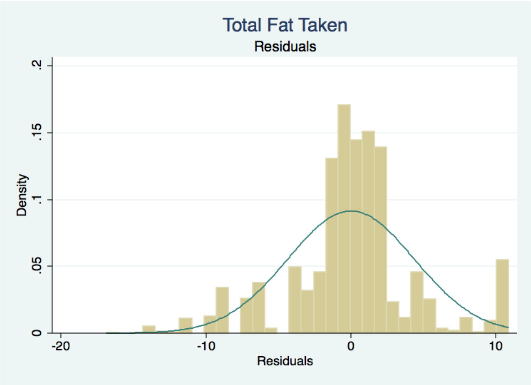








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Residuals
Density
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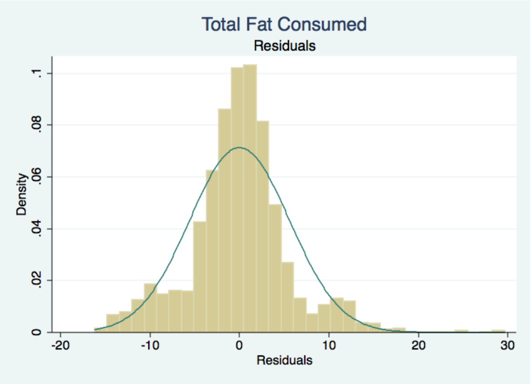
.1
.15
.2
-20
-10
0
10
Residuals


Total Fat Consumed
Residuals
Density
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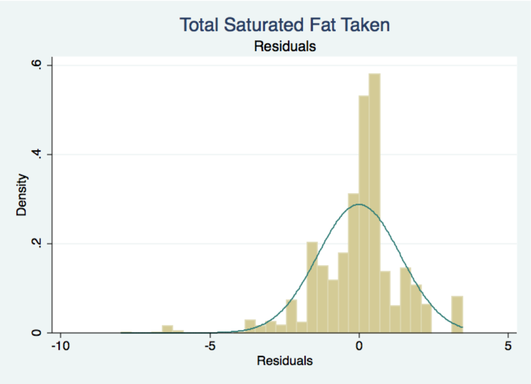
.04
.06
.08
.1
-20
-10
0
10
20
30
Residuals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Residuals
Density
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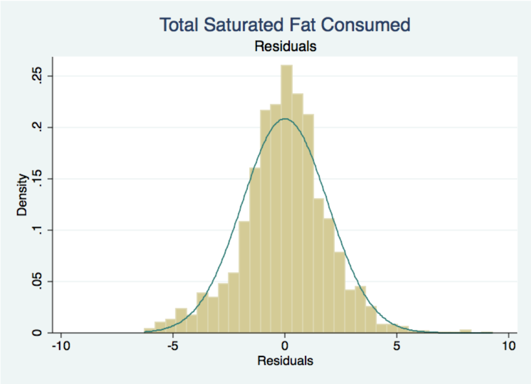
.4
.6
-10
-5
0
5
Residuals


Total Saturated Fat Consumed
Residuals
Density
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0
5
10
Residuals